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THE POSTURE OF SCHOOL CHILDREN

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Frontispiece *Gainsborough*

PLATE I. — PORTRAIT OF J. BAILLIE OF EALING GROVE, HIS WIFE AND FOUR CHILDREN. NATIONAL GALLERY, LONDON.

THE POSTURE OF SCHOOL CHILDREN

WITH ITS HOME HYGIENE AND NEW EFFICIENCY METHODS FOR SCHOOL TRAINING

BY

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To

THE CORPS OF SPECIAL ASSISTANTS

WHOSE STRENUOUS DEVOTION TO DUTY MADE POSSIBLE THE WORKING OUT OF THE EFFICIENCY METHODS HEREIN EXPLAINED, THIS BOOK IS APPRECIATIVELY AND AFFECTIONATELY INSCRIBED

"— with all hearts bowed in the strange control
Of the heavenly voice of his violin,
Why, it was music the way he stood,
So grand was the poise of the head and so
Full was the figure of majesty! —
One heard with the eyes, as a deaf man would."

— James Whitcomb Riley.

PREFACE

THE term "posture" is used in this book to denote the habitual carriage of the body, especially in the erect position. It involves the correct development and contours of spine, chest, shoulders, and other main segments, as well as their relation to each other in the upright position.

Round shoulders and sunken chests are matters of concern to many a parent, and the development of X-ray photography has confirmed the far-reaching harm that may come to both children and adults through failure to achieve and hold the erect position. We now realize that many functional disturbances, both acute and chronic, are traceable to the sag and displacement of organs due to poor posture, so that the carriage of one's head and shoulders may have as much influence upon digestion as the attitude of the chest upon the lungs. As a business and social asset, the position that discloses intelligence and energy can scarcely be overvalued, and its æsthetic power is obvious. Educators have long recognized that provision must be made in school programs for counteracting the detrimental influence of school furniture and sedentary occupations on the postural development of pupils.

To aid both home and school in these matters is the object of this book. Just what constitutes correct development and contours for posture at different ages, is a matter over which many a specialist has been puzzled, and the misconceptions that exist in the popular mind are widespread. How many

parents, for instance, know that a broad, flat chest is the proper type of development after the deep chest of very young childhood? or that the typical collapsed chest of the consumptive has, in most cases, too great a proportionate depth? or that to train a child to "turn his toes out" is to invite falling arches and flat foot?

It has seemed well to bring together in one volume the scattered material on these and related subjects, summarizing the right development of the entire body as related to posture. To this is added the home and school hygiene which has a constant molding influence on posture; also the application of pedagogical principles to the training of posture, and a working description of some new efficiency methods for schools.

These efficiency methods consist of a combination of standardized tests and group teaching worked out by the author during two years of special experimenting. In one year of general use they achieved remarkable results in upward of five thousand classes with 200,000 children. These methods are largely an application of some of the principles of the new school of efficiency engineers, or scientific management experts, — principles that are working a revolution in industrial circles and may do equally important service in education if the way can be found for applying them. One advantage of these methods is that they may be used to enhance the effectiveness of, without disturbing, other means that may already be in use for developing posture.

Much of the material presented in this book was given by the author in lectures at Columbia University during several summer sessions beginning in 1901. The efficiency methods have been presented in many lectures during 1911–1912 to the public school force of New York City. In this book an especial effort has been made to present the material in popular

form, but discussion of many technical points, of interest only to the specialist, is given in an Appendix. The bibliography indicates original sources and channels for further technical study of the subject.

Physical training has grown widely in the last twenty years both in its subject matter and in the recognition accorded it in educational programs. That it is to have a still larger recognition is abundantly evidenced by the widespread interest in public health, and the means taken to conserve it. The particular need for schools lies not so much in finding new material or types of exercise, or in rearranging old material, as in discovering ways of getting better results from those in use. A course of study containing a large percentage of corrective exercises is only one part of the problem, as the improvement in standards of teaching from the use of these efficiency methods plainly indicates.

Full efficiency in caring for the health of children will undoubtedly include better coöperation between the home and the school, and, through both of these channels, more time and opportunity for physical exercise. In schools there should also be much more expert assistance. Meanwhile, the tendency of schools to scatter energy over many types of exercise needs careful consideration if definite results in any one line are to be achieved. What with gymnastic exercise, — taken both with and without apparatus, — folk dancing, games, athletics, story gymnastics, mimetic exercises, and hygienic drills, all crowded into fifteen or twenty minutes a day, it is not surprising that quality suffers at the expense of quantity. In short, the great need of physical training in schools to-day, aside from the ever present want for more time, is not so much the addition of new types of exercise, as new ways of getting and estimating results from those already in use — intensive work, not extensive.

That this need can be met, and the standard of physical development raised, has been abundantly shown by the fact of literally thousands of children who in one year have, through the efficiency methods herein described, learned more definitely than ever before to stand, walk, and exercise in correct posture.

JESSIE H. BANCROFT.

JUNE, 1912.

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WITH ITS HOME HYGIENE AND NEW EFFICIENCY METHODS FOR SCHOOL TRAINING

CHAPTER I

ERECT CARRIAGE; ITS GENERAL SIGNIFICANCE AND DEVELOPMENT IN THE INDIVIDUAL AND THE RACE

THE little child who has not frequently been admonished to "Sit up! sit up straight and hold your shoulders back," is both rare and fortunate. Round shoulders, protruding head, and sunken chest are so often met with in our boys and girls that it is not surprising so many grown people have never learned even the feeling of standing at their full height.

Growing-up is not an easy task; nearly every power of body, mind, and character has to be trained and guided to mature expression; but of all these weak and undeveloped powers none is in need of greater help than that of erect carriage of the body. It is a power lacking entirely at birth, and is acquired in a rudimentary way very slowly in the first two years of life. It usually fluctuates greatly during the years of growth, when bodily proportions and muscular strength change rapidly; and at all ages the erect position has to be relieved by sitting and lying a large proportion of the time. If a fully erect carriage be achieved by the adult, it serves always as a sensitive barometer of fatigue or illness, and, finally, when old age comes, lessened

physical vigor and anatomical changes show in the proverbial stoop of advancing years.

Why should we stand in good posture? If one cares to sacrifice the pride of appearance, is there any other consideration that makes erect carriage of the body desirable or necessary? The answer is threefold and most emphatic: erect carriage of the body is necessary (1) for full vigor and health; (2) to prevent waste of energy in maintaining the upright position in any of the activities of life; and (3) with children, to admit of proper growth and development. To make plainer what is meant by each of these three points, it may be stated at once that only in the perfectly erect position of the body are the great organs of the trunk — heart, lungs, stomach, liver, kidneys, and other viscera that constitute the main working machinery of the body — in a position to perform their work to the best advantage. One may shift and change the posture temporarily with a great deal of positive benefit; indeed, activity in work, gymnastic exercise, or sport is necessary to health; but the habitual bad carriage of the body in walking, standing, or sitting, or a faulty relation of its parts in habitual occupations (as in bending with a cramped chest over a desk or over sewing for many hours a day), may interfere seriously with the great functions of circulation, respiration, digestion, elimination, etc.

For these functions to work at such a disadvantage is, of itself, a waste of energy; and in addition to this, the expenditure of nervous and muscular effort required to maintain an incorrect standing position is greater than that necessary for a good position. The mechanical difficulties of the erect standing position should be appreciated. The body is an upright column, but one that is broken with joints at many points — at the ankles, knees, hips, throughout the entire length of the spine

with its twenty-four separate vertebræ, and where the head is set on the spine. Around each of these joints are muscles and ligaments that help to maintain the different parts, one upon another. In a perfectly poised standing position, the different parts or segments are so balanced that comparatively slight effort is necessary to maintain the position. In a poor standing posture, on the contrary, an unnatural strain is thrown upon muscles and ligaments, and though the stimulus for this strain may be supplied by unconscious nerve centers, the waste of energy and the general lowering of tone and efficiency in the organism are none the less real. Fatigue comes more readily, inertia is apt to be more apparent, and the general sense of well-being is lessened. Moreover, with this lowered tone of the organism the power of resistance to disease is decreased. The germs of tuberculosis and other infectious and contagious diseases will find lodgment and will flourish in a body whose general tone and power are thus reduced, as they could not in one whose machinery is working to better advantage.

To children these general considerations apply as forcibly as to adults, but assume an especial importance, since the great physiological functions have in childhood not only to provide for the waste and repair of daily usage, but must furnish also material and energy for growth and development. Moreover, — and this is of crucial importance, — the posture of the spine, chest, and shoulders throughout the growing period influences profoundly their ultimate contours and proportions. A well-developed chest, a back strong and normal in its growth, and shoulders and head well poised, are points of development that must be held of fundamental importance by every one concerned in the well-being of a little child.

This erect carriage, so important for the conservation of health,

energy, and growth, is one of the marked characteristics that differentiate the human race from lower animals. Man alone achieves the erect position, and his acquirement of it is accepted by anatomists and anthropologists as plainly an evolution from the position of the quadruped. The human spinal column, for instance, is looked upon as "the quadrupedal spine set on end," and no other theory can account for many peculiarities incident to the erect position. For example, the ligaments that support some of the organs are far better adapted to holding them in position when the spine, to which they are attached, is horizontal, than when it is upright. Again, the lack of valves in many of the veins is not the detriment to circulation of the blood in a horizontal position that it is in an upright attitude. These and other disadvantages due to the erect position serve to make clear the need for cultivating that perfect balance in which the great physiological functions are performed to the best advantage.[1]

Offsetting these disadvantages of the erect position are certain very marked benefits conferred by it without which the human race could never have become what it is. Foremost among these is the mechanical advantage which the position gives for use of the hand and arm in the industries that are at the base of civilization.

"In the swinging of the scythe, man instinctively avails himself of the easiest mode of supporting the center of gravity during labor, and that is, the rotary. Man rotates about a vertical axis in nearly every act of labor. The carpenter planing or sawing, the blacksmith, and the miner, are all illustrations of rotary motion, the result of the universal practice of working over one shoulder, which necessitates a twist. . . . Rotary motion in the erect position requires

[1] Clevenger, No. 20 of Bibliography appended to this volume; Baker, 3; Ellis, 35; Lovett, 86.

See Appendix, Note 1.

that one hand should be the principal and one the assistant. . . . One of the reasons why man prefers to use one arm [chiefly] at a time is, that either arm has freer motion when used alone than when both are used together. Man can reach farther in every direction with a single arm than with both." [1]

The relation of erect posture to intelligence and brain development is marked and of great interest. The acquirement of the upright position by the race has been coincident with the development of the higher brain, the cerebrum, and it is certainly not an accident that this position, which admits of a far greater range and variety of movements than any other, should have developed with the nerve centers that inaugurate, direct, and control new movements. In an extended discussion of the relation of brain evolution to erect posture, Dr. Ross maintains that the erect position could not have been acquired without this cerebral development, and says, "The degree of intelligence to which an animal has attained is measured by its capacity of effecting multitudinous changes of attitude." [2]

Applying this principle to an unfortunate class of human beings, it will be recalled at once that among the most marked characteristics of idiots and mental defectives are their collapsed posture and imperfect carriage, their slouching gait, in extreme cases their inability even to stand erect, and their undeveloped capacity for movement, which is often limited to the monotonous, automatic repetition of a few actions.[3]

The man, then, who can draw himself to the full height of a perfectly erect carriage, may well be said to typify in that act, not only a condition for the greatest health and efficiency of the individual, but the long climb upward of the race, through the interaction of movement and intelligence, to all that is implied in the phrase "the full stature of man."

[1] Allis, 2. [2] Ross, 117; Huxley, 153. [3] Johnson, 76; Trettien, 138.

CHAPTER II

HOW TO JUDGE OF CORRECT AND INCORRECT POSTURE; THE VERTICAL LINE TEST

THE young girl in the accompanying illustration (Fig. 1) is standing in a perfectly erect attitude. The long axis or diameter of the trunk of the body is a perfectly vertical line; the long axis of the neck and head taken together is also a vertical line. To assist the eye in determining these points, a line may be dropped from the front of the ear to the forward part of the foot; it will be seen to parallel the axes of these large segments of the body, and at the same time will serve to show that the weight is perfectly balanced in relation to the feet. In poor posture the axes of these main segments of the body (neck and head, and trunk), instead of forming one continuous, vertical line, are broken into two or three zigzag lines, as explained in connection with Fig. 2.

This is the vertical line test. It serves for estimating the poise of the entire body except the shoulders. The shoulder blades should lie flat on the back, but as the clothing may conceal their position, extreme cases of forward or round shoulders may be judged by the relation between the shoulder tip and the ear. If the neck be erect, the middle of the round or tip of the shoulder should lie back of the forward border of the ear. This may be called the ear test for the shoulders.

The effect of ease and buoyancy that this standing position gives is by no means deceptive, for in such posture, and in it

PLATE II. — MELPOMENE. FLORENCE.

alone, does every organ of the body have full opportunity for its work. In this position, also, the girl is at her full height, and the different parts of the body are so poised that the least amount of nervous and muscular energy is needed to keep her in the upright position.

FIG. 1. — A perfectly erect attitude.

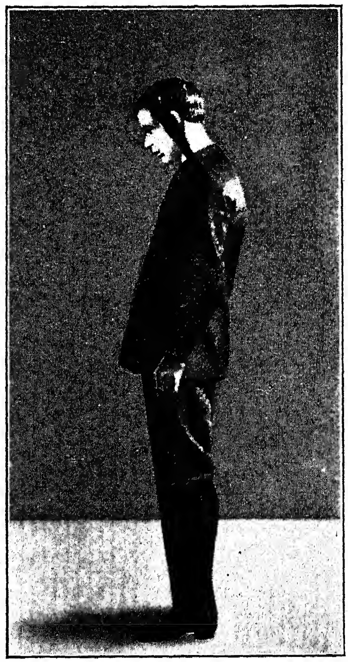
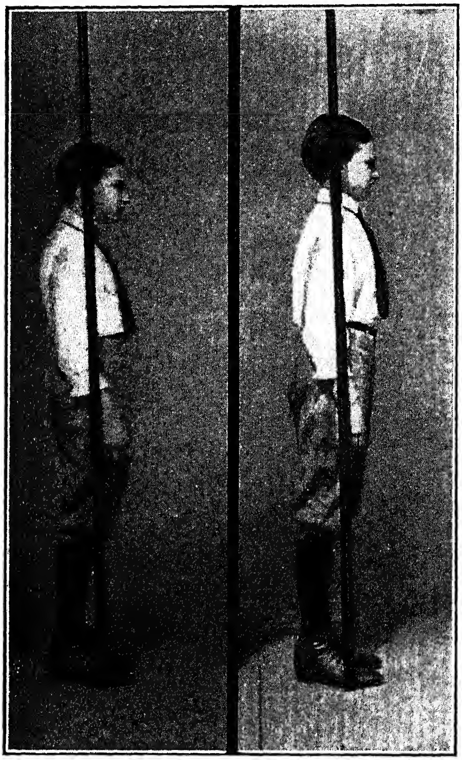


FIG. 2. — Incorrect posture: the "fatigue position."

This vertical line test for erect posture of the body as a whole is equally applicable to children of all ages and to adults. It forms the simplest means of determining good carriage, for in this way one sees the whole figure at a glance, and analytical details appear, as they should, in relation to the whole, and not as detached facts.[1]

[1] Appendix, Note 2.

Bad posture, as already intimated, may also be determined by the use of a line test, but in all types of bad posture the line indicating the general axis of the body becomes a zigzag instead of vertical. For practical educational purposes there are four types of bad posture that need to be considered.[1] The commonest of these is called the fatigue position, because, though unfortunately the habitual carriage of some people, it is the collapsed or relaxed position that any one is liable to assume temporarily when fatigued.



FIGS. 3–4. — The vertical line test made by holding a window pole beside a pupil: poor posture and its correction.

In the fatigue position (Fig. 2) the neck and head droop forward, and the upper part of the trunk sinks backward, so that a straight line indicating the axis of the head, neck, and upper back slopes downward and backward to the region of the shoulders instead of being vertical; the axis of the lower trunk joins this upper line at an angle and slopes in the opposite direction — downward and forward to the hips; a line from this

[1] See Appendix, Note 3.

point to the forward part of the foot would mean still another angle, following a third direction. There are thus, in this fatigue position, three distinct lines indicating the axes of the three main divisions of the body, instead of one continuous, vertical line as in the perfectly erect standing position. The faulty position and its correction are compared with a vertical line in Figs. 3 and 4.

FIG. 5. — The second type of bad posture, with the lumbar curve (natural hollow in the back) obliterated. (*Outline drawing from photograph of a woman by Goldthwait.*)

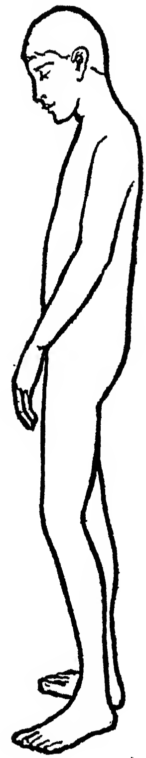


FIG. 6. — The obliterated lumbar curve in a man. (*Outline drawing from photograph by Goldthwait.*)

The second of the four types of bad posture is one in which the lower part of the back is straight. The natural inward curve of the spine at the "small of the back" is obliterated, and the back is straight or even bowed outward at this point (Figs. 5, 6). Accompanying this straight lower back, the line of the neck and head protrudes forward as in the fatigue position. This posture is one of the most harmful, but as a standing position is less frequently found among adults than the fatigue position. It is also rare as a standing position among children, although they cultivate it industriously as a sitting posture.

The third of the four types of bad posture is, in some respects,

entirely different from the first two, being induced by overexertion, rather than by relaxation, as are the fatigue and flat-back positions. It comes from a mistaken effort to lift and expand the chest, which throws the region of the stomach and chest ridiculously forward and upward, like that of a bantam or of a pouter pigeon (Fig. 7). The upper part of the spine is overextended, so that it leans backward and forms a marked exaggeration of the natural curve in the small of the back (lumbar region), — an exaggeration that is known technically as lordosis. This bantam position is not one that a child is apt to assume of himself; it comes almost invariably from a mistaken effort on his part to "make himself tall," or otherwise to get into a good position, — an effort that is often induced by unwise admonitions from his elders. The position is common among very young children and comes from making an effort for good posture before they have acquired the muscular control that is necessary for shifting the position of

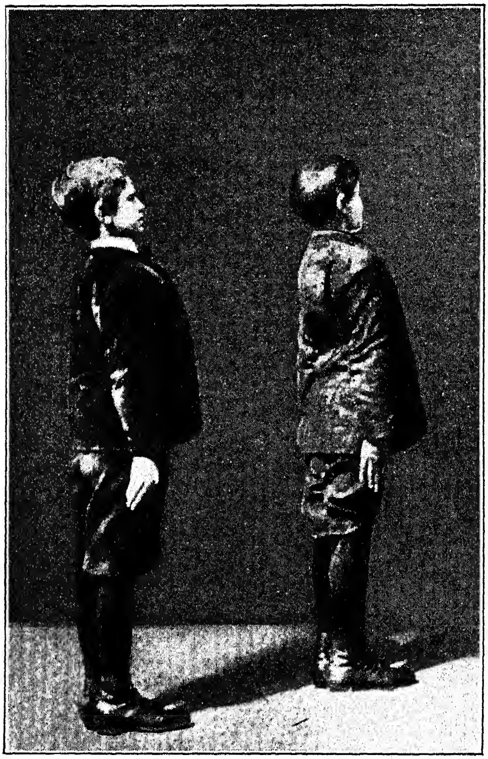


FIG. 7. — Overcorrected posture: the "bantam" attitude.

different parts of the body. It is also found a great deal among older children until they and their instructors learn the difference between a correct and an exaggerated posture. In the case of adults the position seems to be acquired instinctively by portly people in an effort to balance the weight of the front of the body by throwing backward the upper part. The position is also assumed in some cases from a mistaken idea as to what constitutes a good chest. This bantam position is so easily discerned, being usually accompanied by stiffness and effort, that no particular criteria are needed for judging it. To guard against it in children, where it does the most harm, one should be watchful for the extreme hollow in the back, as well as for the lifting too high in front of the chest or breast bone (sternum).

It will be noticed that in all three types of poor posture just described, the faults are those that carry some part or parts of the body too far backward or forward, as head thrust forward, upper spine carried backward, etc. These are called technically antero-posterior deviations from the normal standing position, and may most readily be discerned by looking at the subject from the side or in profile. The fourth type of postural defects is most readily seen by observing the subject from the front or back. These are the one-sided or lateral deviations, of which lateral curvature of the spine, or scoliosis, is the condition most often indicated, and for which one should be most watchful. This condition may usually be discovered through the facts that one shoulder is lower than the other, that the head is carried on one side, that there is a tip, or yielding of the shoulders to one side habitually in standing or walking, or that the hips are of uneven height (Fig. 8). These faults may, or may not, indicate curvature of the spine. If that condition exist, further means for detecting it are available. To trace the line of the

spine itself down the middle of the back with the finger, may disclose a curve to one side; or one shoulder blade may be found more prominent than the other, — an indication of rotation of the spine that often accompanies curvature. Wherever any of these one-sided faults of carriage is found, however, there should be a closer examination by a medical or physical training specialist. It is not for a parent or teacher or any layman to determine whether or not a genuine case of scoliosis exists, and no one but a physician may properly determine how serious it may be. All possible means should be taken to secure proper diagnosis and treatment for such a condition, or to prevent its development if it be incipient.

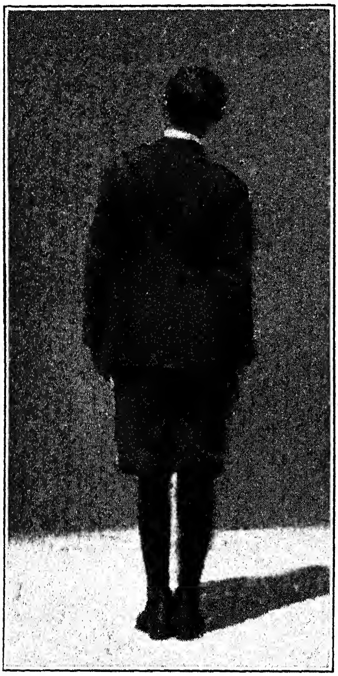


FIG. 8. — Indications of lateral curvature of the spine.

The extent to which bad posture may be observed among adults is astonishing when one learns to recognize it, though we have no figures that give the exact proportion of bad to good posture among them. Of children, it is safe to assert that without special training not more than forty per cent stand correctly, — a liberal estimate, — fifty or fifty-five per cent having antero-posterior faults, and the other five or ten per cent having lateral deviations. This estimate of antero-posterior cases is based on studies made by the author in schools and other public and private institutions of New

York and other cities before the efficiency methods herein described were used.[1]

Lateral deviations of posture, involving the spine, have always been recognized as pathological and have received a large amount of attention from the medical profession. Antero-posterior deviations, while always regarded as undesirable, have been more slowly recognized as a factor in pathological conditions. Physical trainers, as a rule, have always worked for correct posture as one of the main features of a good physique, and there has been quite general recognition of the necessity for definite provision for postural training in school curricula. In the medical profession, recent research with the X ray and otherwise (in disclosure of the extent of displacement of the abdominal organs through antero-posterior faults of posture, and the consequent interference with the functions of those organs) has placed such posture at once, more strongly than ever, among the serious conditions to be reckoned with in bodily health and efficiency.

[1] For statistics of lateral deviations, see Lovett, 86.

CHAPTER III

SOME MECHANICAL DIFFICULTIES OF THE ERECT POSITION

An ingenious way of illustrating the muscular action necessary to keep erect the various segments of the body, is found in imagining the assumption of the erect position by a man on his hands and knees, or "all fours."[1]

Stated in largest terms, the leg is straightened upon the foot by muscles of the calf, the thigh is straightened upon the knee by muscles on the front of the thigh; the trunk, where it joins the legs at the pelvis, or hips, is pulled up into position by the muscles on the buttocks and back of the thighs; the spine throughout its length is held upright by erector muscles on the back, and the head by muscles on the back and sides of the neck attached mainly to the back. It will be seen from this that with the exception of the knees, all of the muscles that pull the body into an upright position are on the back, called posterior muscles; and these are precisely the ones that have most to do with maintaining the erect position when once acquired, for without their support the tendency of the body is to fall forward.[2]

When the different segments of the body — legs, thighs, trunk, and head — are balanced over one another in a well-poised standing or sitting position, the bones, and the ligaments that bind the joints together, do a large proportion of the work of maintaining the position, and the nervous and muscular energy required of the posterior muscles is reduced to a minimum.

[1] Huxley, 153; Ross, 117. [2] Schäfer, 159; Lovett, 86; Feiss, 37.

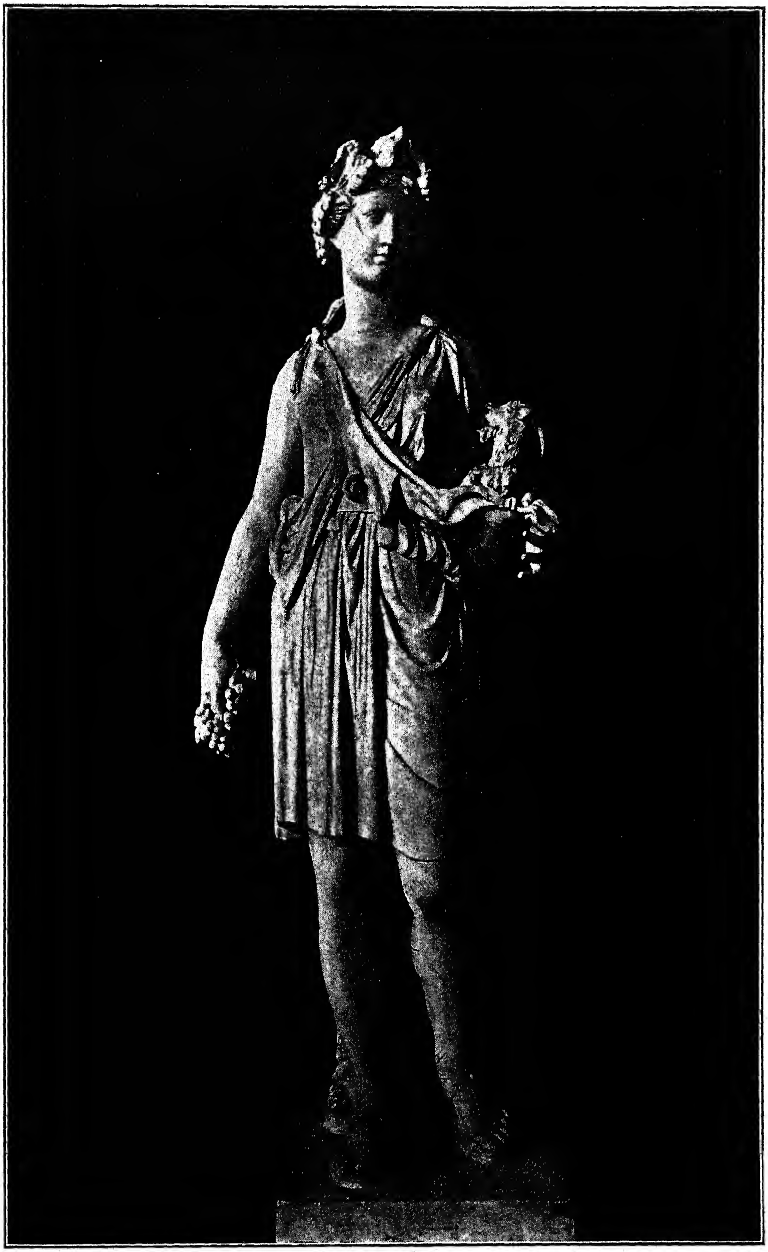


Plate III. — Girl with Goat. Dresden.

When these muscles are weak, or have never been trained to contract properly, the body droops forward in some of the attitudes of poor posture. Similarly, when there is a lessening of nervous energy from fatigue, illness, the nervous depression of worry, or from any other cause, these posterior muscles fail to contract properly because of insufficient nervous stimuli, and faulty posture is the result.

Another continual demand upon the muscles in the erect position is made to keep the center of gravity of this column over a very small base of support, the feet. The center of gravity in the human body — that is, the point around which all of the rest exactly balances — is situated well forward in the region of the hips. Knowledge of the exact location of the center of gravity for living subjects has lacked scientific accuracy until very recently, when Drs. Lovett and Reynolds of Boston have devised a means for determining the center of gravity in any individual (Fig. 9). It is a specially contrived balance that enables the observer, through computation of the weight of an individual with other points, to erect a vertical line through this point.[1]

This balance shows that a vertical line drawn through the center of gravity passes in front of the ankle joints, in front of the knees, and in front of all of the vertebral column except possibly a little in the lumbar region. As shown in the accompanying cut, this line through the center of gravity practically corresponds with the vertical line test for the erect position explained in a previous chapter. The exact location of the center of gravity must, of course, vary in different individuals, for the proportion of parts, and the amount of muscular and adipose tissue, are subject to great variations.

[1] Reynolds and Lovett, 115; Lovett, 86, 87. See Appendix, Note 4.

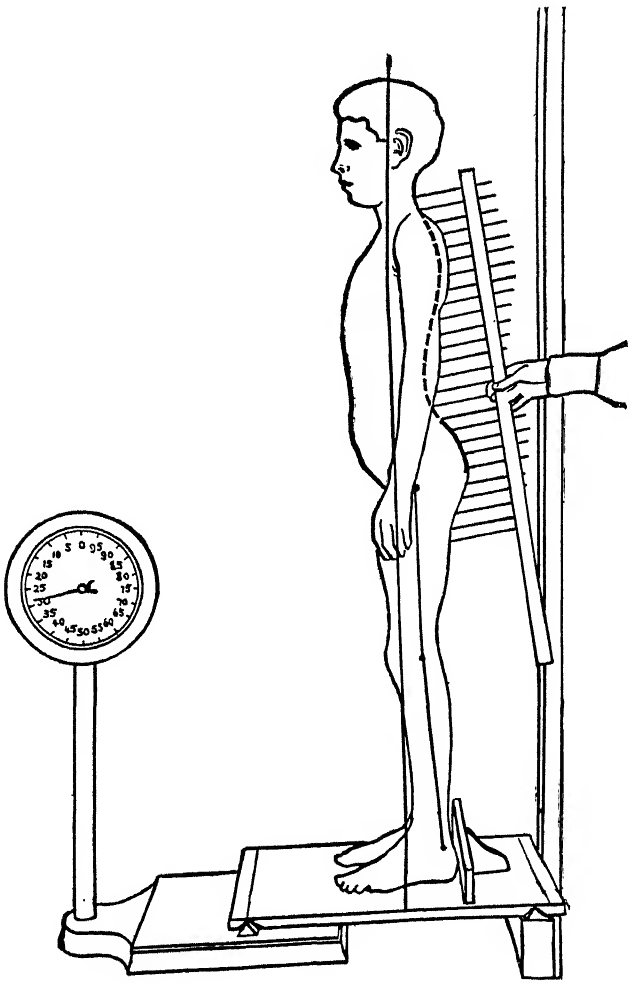


FIG. 9. — The Reynolds and Lovett apparatus for determining the center of gravity in the human body. The vertical line is the perpendicular of the center of gravity which is near the level of the hip joint. (*From Lovett's "Lateral Curvature of the Spine and Round Shoulders." Courtesy of Dr. Lovett, Messrs. P. Blakiston Son & Co., and Jr. Am. Med. Ass.*)

An architect, in designing a tower or column of any kind, gives an unconscious sense of security to the impression that it makes, by enlarging the base somewhat beyond the circumference of the

building above it. While this may not be structurally necessary to insure that the line of gravity shall fall within the base, it satisfies a certain instinct for stability. When the human body is in the erect position with the feet together, the base of support is smaller in circumference than much of the column above it, — a fact that in itself shows how very difficult equilibrium must be. The base may be enlarged by placing the feet in different positions, and the poet Goethe long ago pointed out that walking was a falling forward, the foot being put forth in a step to enlarge the base of support and prevent a fall.

The higher the center of gravity above the base, the more difficult equilibrium becomes, and it is probably not without significance that during the growing years of childhood, when posture is most apt to go astray and when it most needs training and help, the center of gravity is being rapidly lifted through the growth of the legs. Until about fifteen years of a child's age, the legs grow more rapidly than the trunk. Stated in figures, during the first three years the legs grow proportionately one third more than the trunk; from the third to the sixth year of age they grow almost half again as fast as the trunk; from the sixth to the ninth year the legs grow proportionately three fourths more than the trunk; and from the twelfth to the fifteenth more than half as much. After the fifteenth year the trunk grows faster than the legs.[1]

The difference in the proportionate height of the center of gravity in a little child and an adult is well indicated in Fig. 10. Although the center of gravity is not marked on these figures, it is located in the lower part of the trunk in each case.

[1] The best summaries of heights are to be found in Burke, 15; and the study of relative growth of trunk and legs (from which the figures in the text are interpreted) in Tyler, 140. The original sources include Liharzik, Key, Bowditch, Porter, Hastings, and, indeed, practically the entire bibliography on growth of children.

The proportionate height of the center of gravity above the base of support may, then, be considered one of the mechanical difficulties of erect posture at all ages, but especially during the growing period, when a rapid change in height is taking place.

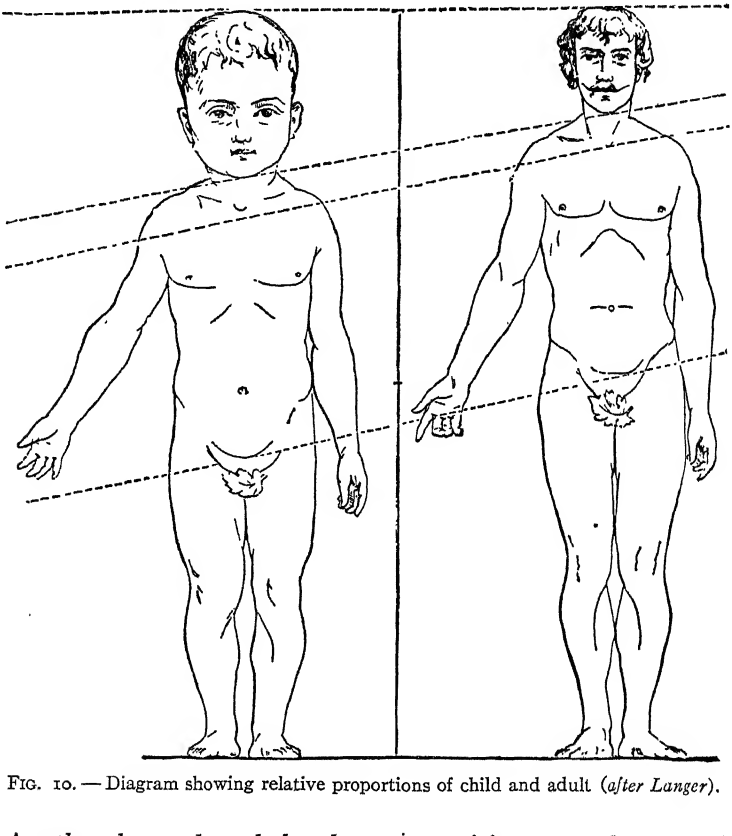


FIG. 10. — Diagram showing relative proportions of child and adult (*after Langer*).

Another demand made by the erect position upon the muscular system is to keep the center of gravity over the base of support, and this is not always done by changing the position of the feet as in walking. If one part of the body, say the trunk, be bent forward at the hips, the body will topple over, unless some other part, the thighs, be thrown correspondingly in an opposite

direction, to counterbalance the weight (Fig. 11). This instinctive shifting of balance, while one of the most useful propensities of the human mechanism, is nevertheless responsible for some of the worst faults of posture. For instance, if the weight of the head, instead of being perfectly balanced on the spine, be allowed to droop forward, some other part, usually

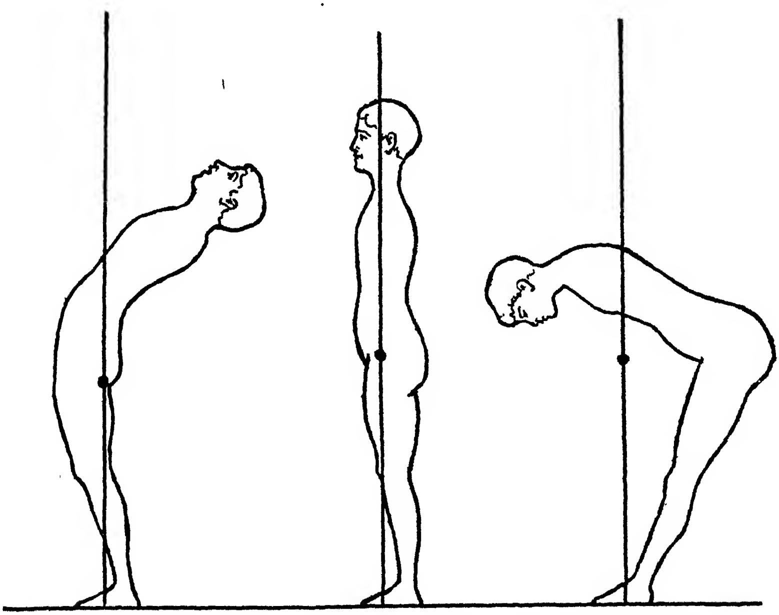


FIG. 11. — Diagrams showing the mechanical reactions of the body whereby the center of gravity is kept over the feet. The center of gravity is indicated by a dot; in the third figure it is outside the body entirely. (*Adapted from Schäfer; center of gravity placed according to Lovett and Reynolds.*)

the upper part of the trunk, will sink correspondingly backward to keep the weight equally balanced around the center of gravity. The same thing happens if the shoulders be so far forward that the weight of the arms falls in front of a balanced position; the back, carrying the chest downward and backward with it, will then round out to equalize the distribution of weight. The same mechanical principle applies to one-sided effects.

It will be seen that in many ways gravitation is a constant force to be resisted in maintaining erect posture. Dr. Sargent graphically sums this up in the following paragraph:

> "From the time a child leaves its mother's arms and begins to stand and walk alone, there is a force with which it, in common with the rest of mankind, is always contending; this force is *gravity*. We are battling with this force from morning till night, yielding to it partially as opportunity offers to assume a sitting position, and finally yielding to it completely, as we do each night when we sink to rest in a horizontal position. But this force not only acts upon the body as a whole throughout the day, but upon each individual part of the body. Thus the head tends to drop forward, the shoulders to round over and droop forward, the back to curve, the chest to become flattened and compressed, the knees to bend, the arch of the foot to break down, etc. This is nature's attempt to seek an equilibrium . . . and the only way that this downward tendency can be overcome is by the constant exertion of muscular force." [1]

In walking or any other activity of the body, this instinctive mechanical reaction is always present. In this connection, notice the undulating movement which the artist has caught in the walk of the Greek girl shown in Plate III.

It is apparent that in erect posture no one part of the body can be considered alone. Head, chest, shoulders, spine, pelvis, and feet, in order to preserve a mechanical balance, if for no other reason, are so interrelated that any change in the position of one is accompanied by changes in the others. It therefore becomes important to know just what constitutes the correct contours, development, and carriage of these different parts at different ages, as well as their general relation to each other, and these points will be considered separately in succeeding chapters.

[1] Sargent, 122.

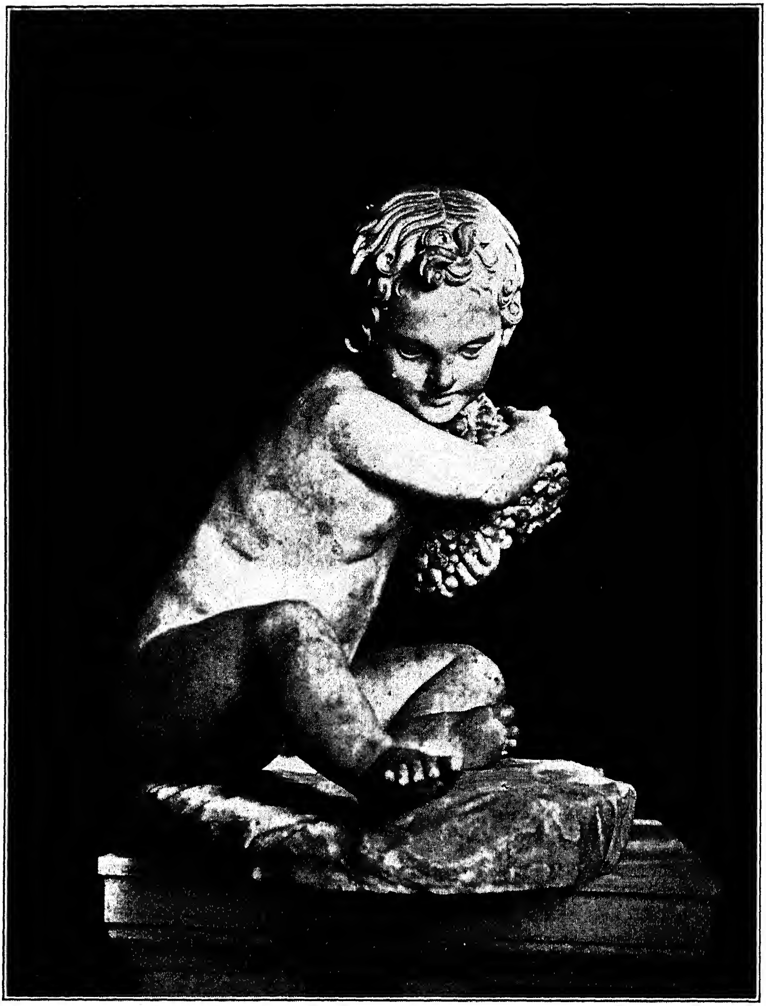


PLATE IV. — INFANT BACCHUS.

CHAPTER IV

THE SPINE, *I:* ANTERO-POSTERIOR CURVES AND THEIR FAULTS

THE spinal column, or spine, is of fundamental importance in any consideration of posture, for aside from changes in its own position, it influences, more than any other part of the body, the position of the organs of the trunk, or viscera, as well as other important bony sections that are attached to it, — the head, chest, and pelvis (Fig. 12). Moreover, through its many joints, the spine becomes especially sensitive to changes in the position of other parts of the body, so that it is continually called upon to shift its curves to maintain the equilibrium. It is therefore not surprising that it should be involved in almost all faults of posture, and a primary object for attention in any effort at correction.

The spine is made up of twenty-four separate bones — the vertebræ — and a comparatively large, flat, and roughly triangular bone at the lower end called the sacrum. To the sacrum is attached the large bony rim (the pelvis), called "the floor to the trunk," of which the hips are a part. A very small bone beyond the sacrum (the coccyx) completes the spinal column, but is unimportant.

In its normal, upright position the adult spine has several very pronounced curves from front to back (antero-posterior curves) that add to its flexibility, so that it yields to jar like a spring, preventing shock to the spinal cord within it. Its movement, or flexibility, is greatly increased by little elastic cushions or discs of cartilage between the vertebræ. These

discs are compressed and become temporarily thinner whenever the edges of the vertebræ above and below them are forced closer together in a bending movement. Indeed, these little cartilaginous discs have more to do with the natural or physiological curves of the spine than the bony vertebræ themselves, for it is mainly by means of their differing thickness at different points that the vertebræ are tilted to form these curves. Without the discs the spine would lose not only much of its curving outline, but also much of its power to move or bend in any direction. In old age it is largely the permanent shrinkage of these cartilage discs that leads to a stooping posture. These little cushions or discs of cartilage are of very great importance in posture, because if they are compressed too much habitually in any one direction, instead of resuming their normal thickness when released, they become molded to the new shape; there then comes a pressure on the bones (vertebræ) which may alter their structure, too, so that the spine may become permanently deformed, and unable to assume its proper position. This is what often happens in lateral curvature of the spine, and it may occur also in the exaggerations of antero-posterior curves that are found in most poor posture.

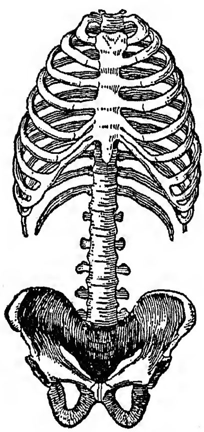


FIG. 12. — Spine, chest, and pelvis.

The vertebræ are numbered from above downward in three series, each series forming one of the natural antero-posterior curves of the spine (see Fig. 14). There are seven vertebræ in the neck, called cervical vertebræ, which form the cervical curve; below these are twelve, to which the ribs are attached, called the dorsal or thoracic vertebræ, which form the dorsal

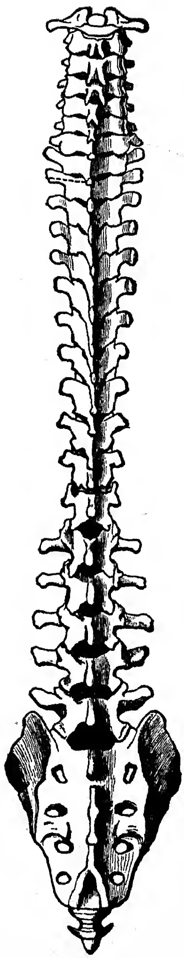


FIG. 13.—View of the spinal column from the rear.

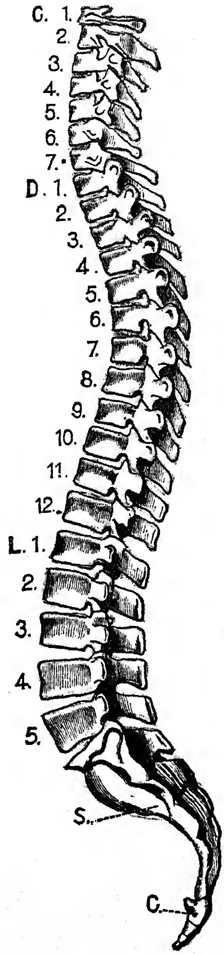


FIG. 14.—View of the spinal column from the side, front to the left: *C*, cervical; *D*, dorsal; *L*, lumbar; *S*, sacrum; *C*, coccyx.

curve — a curve which is largely overlaid by the shoulder blades; and below these dorsal vertebræ are the last five, situated in the "hollow of the back," called the lumbar vertebræ, which form

the lumbar curve. Below this the outward curve of the sacrum in the region of the buttocks is sometimes called a fourth physiological curve in the spine.

It will thus be seen that the cervical vertebræ, being in the neck, affect directly the position of the head; the dorsal curve, having the ribs attached to it, has an immediate effect upon the chest, and the lumbar curve, being between the chest and the pelvis (hips), affects directly the position of both of those parts. This is not meant to imply that each of these curves does not affect other parts than those specified, but merely that its most direct effect is discernible in the position of the parts mentioned. The neck may best be considered in connection with the position of the head, and will be discussed in the chapter on the head; the dorsal and lumbar curves are the subject of the present chapter.

These two curves, the dorsal and lumbar, are the great offenders in posture. The lumbar curve is one of the most beautiful in the body (Fig. 15), and artists very often pose a figure so as to get the best view of this curve from the back or sides. Thus it is shown, slightly exaggerated by a transitory backward movement, in Plate XXV. As regards power to maintain its normal contours, the lumbar curve is, nevertheless, one of the weakest points of the spine. Its commonest fault is a failure to hold up the dorsal part of the spine or upper trunk, which it allows to sink backward and downward, so that both the dorsal and lumbar curves become exaggerated. Just what is meant by this sinking backward of the upper part of the trunk will be made clearer by reference to Figs. 3 and 4 in Chapter II. There it is shown that in the fatigue posture the front outline of the upper chest is close to the vertical line; in Fig. 4 (the corrected posture) the entire upper part of the trunk has been brought

part.[1] Again, the lumbar region has a greater flexibility and range of movement than any other part of the spine except the neck, and this very facility may be another cause of weakness. With the sinking backward of the dorsal spine, the head is almost invariably protruded forward, — an unconscious effort for mechanical balance undoubtedly being a factor in the position of the head.

However it be accounted for, the fact remains that an exaggeration of the dorsal and lumbar curves, through a sinking backward of the upper part of the trunk, is the chief fault in a large percentage of cases of poor posture and is invariably present in the fatigue position. This fact may be easily detected in the contours of the body in various ways, but the slanting, instead of vertical, direction of the axis of the trunk is the most obvious. The extreme hollow in the back is another point to note for the exaggeration of dorsal and lumbar curves. Seen from the front, as the dorsal curve (upper part of trunk) sinks backward and becomes more pronounced, the chest sinks downward and backward with it, for the attachment of the ribs to the dorsal spine is such that the position of one cannot be altered without affecting the other (Fig. 16). The abdomen also reflects this position of the back; its muscles become relaxed and fail to hold the viscera in place, so that the sag of these below, and the backward carriage of the trunk above, give the abdomen the appearance of protruding forward.[2]

In the second type of relaxed posture described in Chapter II (Figs. 5 and 6) the lumbar curve is affected in just the opposite way; that is, instead of being exaggerated or intensified, it is practically obliterated, the back at that point being made flat by a bowing outward or reversal of the lumbar curve. The

[1] Goldthwait, 48 and 49. [2] Appendix, Note 5.

immediate result of this position is to tip the rear edge of the pelvis downward, and tilt its front edge upward, so that it bears an entirely different relation to the trunk than is normal. In this position, the weight of the heavy abdominal viscera above the lumbar curve bears directly downward on the pelvic contents as it should not, for in the normal position the muscles on the front of the abdomen take a large part of this weight.

The outline of the back in children appears very different at different ages, and the trained expert sees the development of the natural antero-posterior curves much earlier than they are distinguished by the lay mind. Technically, the dorsal curve is present at birth, the cervical curve is said to appear when the head is first held up, and the lumbar curve appears when the legs are straightened in line with the spine.[1]

FIG. 16. — Effect of exaggerated dorsal curve on position of chest (*Jegi*).

The curves of the spine in childhood are somewhat different in the sitting and standing positions. In sitting, the lumbar curve is often obliterated, making the spine practically straight, until a child is about thirteen years of age.[2]

In a standing position the curves are more apparent. In judging the contours of the spine for educational purposes, the appearance of the back, especially in children of school age with the clothing on, is of even more importance than the actual

[1] The order and age for the appearance of these different curves varies somewhat in the statements of different authorities, but they agree that the curves are present habitually in the standing position by three years of age. See Cunningham, Aeby, Dwight, Rasenal, Lovett, Davis and Montgomery. For summaries, see Rotch, 118; Cotton, 24; Lovett, Davis and Montgomery, 89; Lovett, 86.

[2] Lovett, Davis and Montgomery, 89; Lovett. 86, p. 14.

anatomical facts as they appear to the expert on closer examination. The back of a baby, sitting on one's knee, is straight and square (see Plate IX). Stand the little one on its feet, and the back curves out over the buttocks.[1]

When a child enters the kindergarten at four years of age, the back appears to be perfectly straight above the buttocks. This straight back (Fig. 17) is characteristic of a child standing in good posture until about the third grade (nine or ten years of age), when the lumbar curve begins to be a noticeable feature of the contours in a standing position. The degree or depth of this lumbar curve, or hollow in the back, varies with different children, and always, after the curve becomes apparent, it blends into the lower part of the dorsal spine, so that both curve outward and upward just above the greatest hollow in the back. Assuming that all of that part of the spine which is concerned in the hollow of the back may be called the lumbar region (and for practical school use this is the easiest identification), the back from there up should appear practically flat. In judging the contours of the figure in the region of

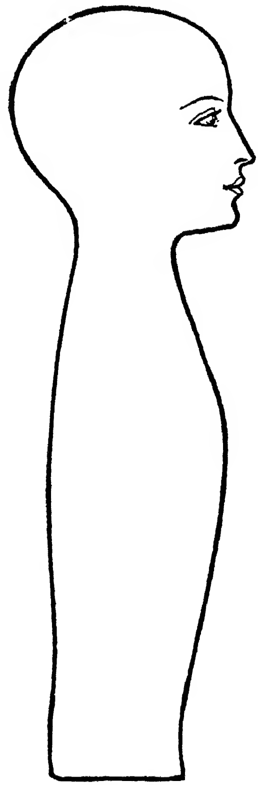


Fig. 17.— Contours of six-year-old boy (*Symington*).

[1] The bony foundation for this curve of the buttocks is, at all ages, the sacrum, with a slight outward curve of the lowest lumbar vertebræ blending with it. The lumbar curve at all ages may be definitely located by the top of the hip bone (ilium), which is always on a level with next to the lowest vertebræ (the fourth lumbar).

the shoulders, one must remember that the shoulder blades (scapulæ) are nearer the surface than the spine, and have much to do in determining the contours. If the shoulder blades are not flat on the back, they may give the back an appearance of bowing out at the shoulders, when the dorsal curve itself may not be exaggerated. When the spine is involved, the running forward of the neck is always a sure indication. If the shoulder blades are correctly placed, the back should appear flat in the dorsal region.

When children reach the upper grades of the elementary school (twelve to fifteen years of age), the curves of the spine all become more pronounced. The clothing of boys so conceals the figure, that until one has somewhat acquired an X-ray ability to discern what is beneath, it is far easier to judge by inference with the line test for the whole trunk if the curves of the spine be normal. In girls, the dress usually aids the discernment of the contours of the spine, at least in the lumbar region, and the increase in growth in the length and depth of the lumbar curve may be plainly seen. This curve is more pronounced in grammar grade girls than in boys of the same age, foreshadowing the adult lumbar curve, which is longer and deeper in women than in men.

Such, then, are the contours of the erect spine throughout the years spent in the elementary school. If every child grew normally into these contours, there would be much less need for physical training than at present. Unfortunately, however, the exaggerations of the curves already described occur in a majority of children at some time through the growing period, if definite training be absent. The weak place in the lumbar curve, especially, begins to show in the first primary grade, or even in the kindergarten with children six years of age, in a sinking backward of the upper part of the trunk. With these very little

children this is not necessarily an habitual attitude, — which it may become later, — but constantly recurs in a fluctuation from the erect position, a fluctuation that is one expression of the undeveloped motor power of these very young children. They lack steadiness, precision, and strength in all of their movements — an immature state that is perfectly natural and characteristic at that age. This weak motor power shows in no way more clearly than in the instability with which these little children hold the erect position. How early one may begin to train the sense of erect posture, and the muscular power to maintain it is among the most serious and difficult of the many teaching problems connected with this subject. The writer's judgment is that the second year of the primary school (when pupils are in their eighth year of age) is soon enough for definite, formal training in posture, though some of the muscular control necessary for it may be begun with a very little formal gymnastic work before that time. Before the seventh or eighth year of the child's age, however, the informal activities of many of the kindergarten games, and the story gymnastics and recreative exercises of the lower primary grades, may be good means of approaching the subject, if carefully selected with that end in view. Even from the lowest grade one needs to be watchful for the inherent weakness in the lumbar spine. Throughout the school years the entire spine, but the lumbar region especially, needs attention and training for muscular strength and right habits of carriage.

CHAPTER V

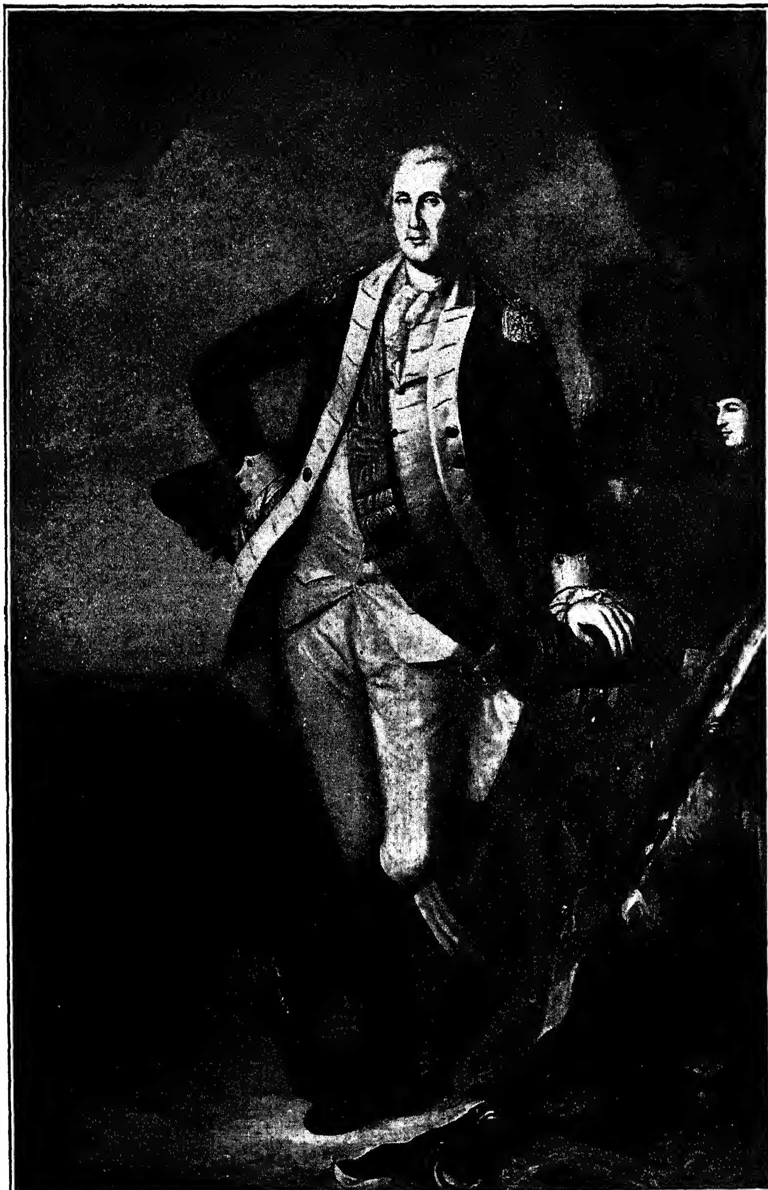
THE SPINE, *II:* ANTERO-POSTERIOR CURVES; THEIR EFFECTS ON TRUNK CAPACITY AND HEALTH

THE importance of proper erectness in the spine, and the harm that comes from exaggerated curves, lies primarily in the fact that the latter affect the diameters of the trunk, altering its proportions. Trunk capacity, or relative size of the trunk, is one of the most important elements in a good physique, for it implies relatively large organs and plenty of room in which they may do their work, — in short, the right conditions for a large working machinery for the body. It is usually found that men of large endurance and achievement, who have not had to struggle against the handicap of ill health, have relatively large trunk capacity (Plate V). This is very apparent in Washington and Lincoln, in whom the trunk forms a relatively large proportion of the height.

Dr. Tyler discusses [1] the general tendency to weakness when a proportionately large part of the total height is made up of length of legs; and the greater strength and vigor of the organism when the size of the trunk is proportionately large. He bases much of his argument for education at different ages on the relative proportion of the trunk to total body height, because of the related physical and mental vigor, liability to disease, etc.

Trunk capacity may be small in a tall person, or large in one

[1] Tyler, 140; pp. 153–154, 160–161.



Peale

PLATE V. — WASHINGTON.

(Courtesy Metropolitan Museum of Art.)

who is short, the total height being determined by the length of legs. The sitting height is usually considered a general indication of the height of the trunk, or its capacity in its long or vertical diameter.[1] The depth (from front to rear) and breadth (from side to side) give other means of estimating the size of the trunk and are called respectively the antero-posterior and lateral diameters. Finally, the girths, giving the total circumference of the trunk, are an indication of size and very important, though as regards correct posture and proportionate development of the chest, they are far less enlightening than the diameters, for girths do not show the relative contours and position of the different parts.

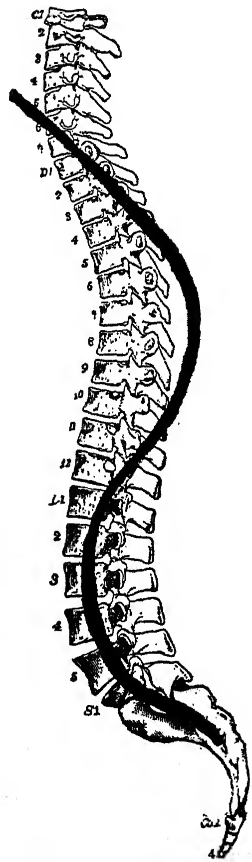


FIG. 18. — Showing how height is decreased by exaggerated curves in the spine.

When the antero-posterior curves of the spine are exaggerated or increased, as in poor posture, they lessen the vertical diameter of the trunk. In Fig. 18 the dark line, measuring in length exactly the same as the spinal column on which it is placed, is drawn in exaggerated curves analogous to those of the spine in poor posture. The difference in height is at once apparent. The author has measured pupils in the classroom who showed a difference between good and poor posture of from one to three inches in the total height of the body. Dr. Goldthwait has

[1] For table of sitting heights for different ages, see Chapter VIII.

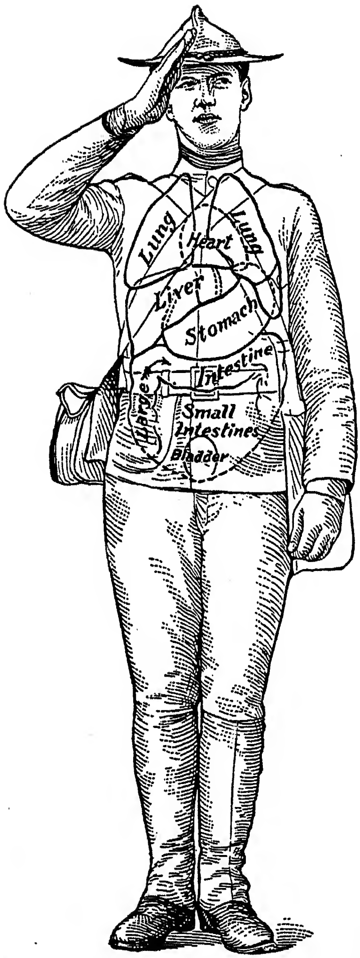


FIG. 19.—Relation of the organs of the chest and abdomen to the clothing. (*From Pilcher's "First Aid," by courtesy of Messrs. Charles Scribner's Sons.*)

reported a variance from the true height of from one half to three quarters of an inch as a result of the second type of poor posture — that in which the lumbar curve is obliterated and the back flat. The antero-posterior diameter of the trunk, or its depth from front to rear, is also affected by these faults of posture, especially in the upper part of the chest, where is situated the apex of the lungs, in which tuberculosis is likely first to develop.[1]

It is needless to say that the proportions of the trunk cannot be thus altered without crowding or displacing the organs in a manner that interferes with the circulation through them and the performance of their own functions.[2] Unless one reflects on the fact, he does not appreciate how large a part movement plays in the functioning of the thoracic and abdominal organs. For example, respiratory action, the work of the heart, and the digestion of food are all impossible without

[1] Goldthwait, 48.

[2] Goldthwait, 48 and 49; Kellogg, 77, 79, 80, 81; Herz, 64; Forbes, 41; Martin, 96, 97.

muscular contraction and relaxation in the organs concerned. Of especially grave importance, however, is the actual displacement of organs through poor posture. The X-ray work of Drs. Goldthwait, and Brown, and Martin has shown that through displacement from poor posture the stomach may be put in such a position that the food cannot pass out of it. There is scarcely an organ of the trunk of the body that has not been found very seriously displaced through poor posture. The functional disturbance arising from such displacement has far-reaching effects, and through the lowered tone and vigor of the system that results, the power of resistance to disease is greatly lessened. On these points Dr. Goldthwait says: —

"The sides and anterior wall of the abdomen consist practically wholly of muscle, the arrangement of the fibers being such that the greatest elasticity exists without sacrificing the element of strength. The proper tone of this anterior muscle wall is an important part of the support of the abdominal viscera. Besides this, the viscera are supported by ligaments, by the formation of the bony framework, and by the arrangement of certain of the structures so that definite ridges or shelves exist, upon which the organs naturally rest. When the body is erect, all of these elements work to the best advantage. All of the abdominal muscles are made tense so that the organs are held firmly together with little liability to drag out of place. The ligaments are subjected to the least strain, and the organs rest most securely on the ridges or shelves. . . . In this position the kidneys cannot become displaced, the stomach cannot drag downward, nor can the other viscera change their normal relations to each other. Under such conditions there is also the least possible interference with the circulation, which, together with the freedom from strain of any of the structures, would naturally insure the greatest efficiency in their function."

And again,

"Since the normal function of the organ must depend to a considerable extent upon the position (because of the arrangement of the

blood vessels and nerves, as well as because of its relations to the other organs), the importance of training the body to habits in which there will be the minimum of displacement of the viscera cannot be overemphasized."

If these matters are important to an adult, they are even more so to a child, for besides supplying the waste and repair of daily activities, the great functions have in childhood to provide for the enormous growth in bulk that must take place. When a boy enters the elementary school at six years of age, he has but one third of a man's weight. During the elementary school course he gains fifty or sixty pounds, and in the high school adds thirty or forty more. Besides adding to the other tissues of the body, the organs that are supplying all this material have at the same time to undergo a great increase in size, for this is their growing time also. During the elementary school period, for example, the heart more than doubles in weight, the lungs gain practically three times their weight, and the liver more than doubles.[1]

Indeed, the most rapid weight increase of heart, lungs, liver, kidneys, and spleen occurs from twelve to fifteen years of age, just at a time when a slouching carriage most often attracts attention. Such a weight, pulling directly or indirectly upon the spine, cannot but have its influence on posture, especially if, as Donaldson suggests,[2] the most rapid growth of the muscular system comes later, so that the muscles are comparatively weak for the great increase in weight which they must support in these later grammar school years.

It is apparent from all of these facts that there is no time in life when poor posture could do more lasting harm to physical condition and development, or good posture be of greater advantage, than during the school years.

[1] Vierordt, 162. [2] Donaldson, 32.

Plate VI. — Sitting Philosopher. Louvre.

The Bowed Back of Age.

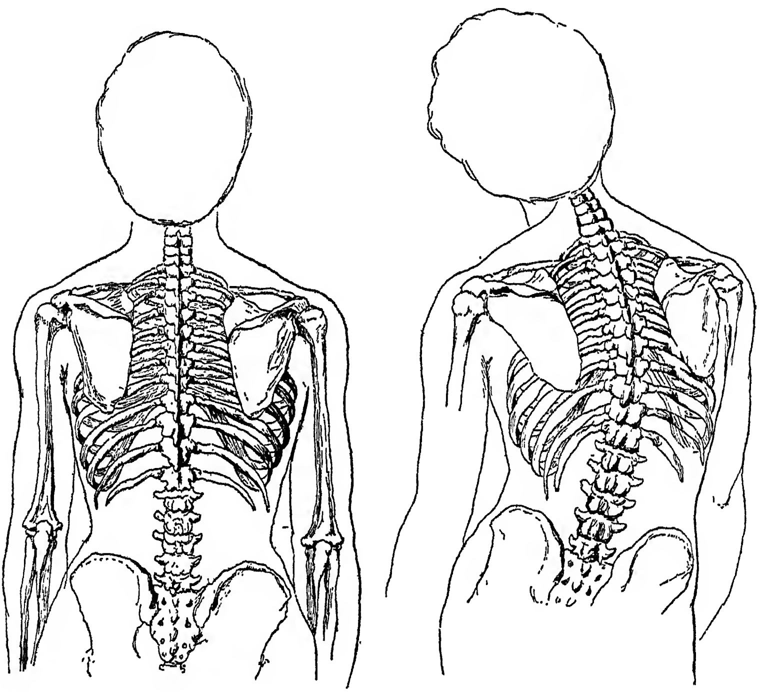
CHAPTER VI

THE SPINE, *III:* LATERAL CURVES

The ways of detecting lateral deviations from the erect position of the spine have been described in Chapter II. Whenever indications of one-sidedness are found, the judgment of an expert should be sought at once to determine whether or not the spine itself be affected. Sometimes from some habit of posture or occupation, one shoulder may be lower than the other without involving the spine. This can usually be corrected by special exercise. Sometimes a defect in the eyesight may cause a one-sided carriage of the head, and the oculist may remedy that. Whatever the cause for one-sided carriage, it is of much importance that it be found and removed, for eventually the spine may become affected.

In most cases that show one-sided asymmetry there will probably be found a lateral curve of the spine. The accompanying cuts show the difference in outline made in the skeleton (Figs. 20–21) and in the full figure (Figs. 22–23), by a single lateral curve of the spine. In the full figure note the different heights of the two shoulders from a horizontal line, and similarly the height of the axilla (armpit) and the hips. The divergence of the spine and head from the vertical line are equally apparent. There may be two lateral curves in the same spine, instead of only one, as shown in these illustrations (see Fig. 60); often there is easily discerned a rotation or twisting of the spine to one side. In the case of such rotation one shoulder blade may

become more prominent than the other. As before stated, it is not for a layman to decide whether or not a lateral curve of the spine exists, of what kind it is, or how serious. Any case showing these one-sided deviations should be referred at once to competent authority for diagnosis, preferably to a physician who has specialized in orthopedics.



FIGS. 20–21.—Differences in the position of the skeleton in the normal attitude and in lateral curvature of the spine. (*From Mosher's "Health and Happiness," by courtesy of Dr. Mosher and Messrs. Funk and Wagnalls.*)

Lateral curvature of the spine, or scoliosis, is classified in two main divisions or groups, according to its severity, one called functional or postural scoliosis, and the other structural scoliosis. In postural, or functional, scoliosis, the actual structure of the spine itself has not been altered, and the position probably

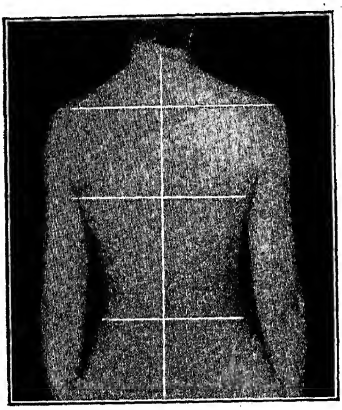
comes from a weakness or habitual one-sided use of the muscles. Vigorous special treatment, of which gymnastics may form a considerable part, is necessary for such a condition and may entirely remove it. The child's own sense of the erect position, and his power to assume it, should be especially trained and appealed to. Good school gymnastics should benefit such a child, though in most cases not enough and not sufficiently specialized for him. He should have ample outdoor exercise, and nourishing food; he should avoid the carrying of heavy weights, and overwork in any form; in short, he should have good hygiene in all particulars to keep the constitution vigorous.

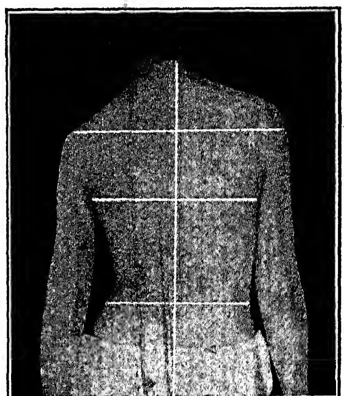
In structural scoliosis, which is much more serious, the shape of the bones and cartilage discs has become affected, and it is of great importance that these changes be checked, and if possible corrected. Scoliosis is more amenable to help during years of growth than later, and the treatment by a specialist should have faithful, persistent coöperation from the patient, as the condition cannot be quickly overcome.

Scoliosis and its treatment are not necessarily painful unless there be complications. The curvature leads, in most cases, however, to weakening of the constitution, that renders the individual less robust, more susceptible to fatigue, and places him otherwise at a disadvantage. In the crowding and displacement of the internal organs, the effects are analogous to those resulting from antero-posterior faults of posture. Indeed, the antero-posterior types of poor posture often accompany scoliosis, and Dr. Goldthwait suggests that they may precede and lead into scoliosis. Children with lateral curvature of the spine need not be excluded from regular school gymnastics, unless they be wearing a brace, cast, or jacket, unless they complain of pain, or, because of some complication, the physician has ordered

suspension of exercise. Where there is a tuberculous condition of the bones, exercise of any kind is considered harmful, but with the exception of the conditions mentioned, positive advantage may accrue to a scoliosis case from the general upbuilding of the system through gymnastics and other exercises. If not carried to the point of fatigue, the change of position which these activities afford, and their definite training of the muscular sense of erect posture, are also a positive advantage.

It should not, however, be thought for a moment that the





FIGS. 22–23.—The normal position and lateral curvature (*Mosher*).

usual school exercise, designed for normal children, is sufficient for the correction of scoliosis cases even of the mildest functional type. It is to be hoped that in time there will be a large enough corps of physical training specialists in our schools to give corrective exercise to such cases under medical advice and coöperation. A considerable number of pupils having lateral curvature could be gathered together in any large school or group of schools. Such work in school will probably always be the only way to secure regular and adequate help of this kind for

many children, whose after-school conditions are not favorable to proper treatment, even at free clinics.

Exercise, however, is by no means the only or the best means of treatment for many cases of scoliosis, and, indeed, in structural cases it may be of no use. So it becomes important to repeat that all cases of lateral deviation should have medical advice.

The subject of lateral curvature will not be dwelt on in succeeding chapters, as the main concern of the present work is with antero-posterior deviations.

CHAPTER VII

THE HEAD

The position of the head is of much importance in the general posture of the body, because of its direct influence on the spine, chest, and shoulders; it also affects the position of the stomach, liver, and other abdominal organs which are suspended secondarily from the neck. In a perfectly balanced position, where the least muscular effort is required to maintain it, a considerable part of the head and neck is carried back of the line of gravity. This line of gravity is well in front of the ear, — just how far may vary in different individuals.

The erectness of the head may best be judged by the contours of the neck, for the two are so closely associated they cannot be considered separately.

The proportionate length of the neck is very different in infants and older children, being relatively very much shorter in a baby (see Plate IX). This is because the first rib lies horizontally in the infant, its front attachment to the sternum, or breast bone, being directly opposite the first dorsal vertebra, to which it is attached at the base of the neck behind. Later the sternum sinks in front so that the first rib slants downward and forward, making a longer throat line. In adult men the top of the sternum is opposite the second dorsal vertebra, and in women it is still lower, being in them opposite the third dorsal vertebra. This gives to women the appearance of having a longer neck and throat than men have.[1]

[1] Gray, 152; Dwight, 149; Piersol, 157; Fitterolf and Gittings, 38.

F. D. Millet

Plate VII.—Detail from Thesmophoria, Pittsburgh.

(Copyright by F. D. Millet. From Copley print, copyright by Curtis and Cameron.)

The vertebræ in the neck are of no help in determining the contours, for they lie so deep under other tissues that except at the very base in the back, where they blend into the outward and downward slope of the dorsal curve, they are not apparent in the outlines. The natural curve in the cervical vertebræ is with the concavity facing to the rear, or in the same direction as the lumbar curve. The common fault in bad carriage of the neck and head is that they droop forward, yielding to the pull of gravitation. This makes the column of the neck slope forward instead of being upright (Fig. 24).[1] The effect of this forward droop of the neck on the cervical curve must be to obliterate it, just as the lumbar curve is obliterated in the straight-back position described in Chapter II as the second type of poor posture.

When the neck slopes forward in this way, the effect on the spine, chest, and shoulders is to drag them downward and forward also. In such a position of the neck, the back is affected through the dorsal curve. This shows in the upward and forward slope of that curve, which, instead of blending in outline with only the lowest two cervical vertebræ, is continued in a long line forward throughout the length of the neck. The back is thus bowed out under the shoulder blades, in an exaggeration of the natural dorsal curve.

With this increased dorsal curve the chest sinks downward and backward, an effect that is intensified by the relaxation of an important muscle (the sterno-cleido-mastoid) on the sides and front of the neck, which, with its colleagues, influences the relative position of the chest and head. This muscle is attached to the head at the lower part of the skull just back of the ears, and comes forward and downward, spreading out to be attached in front to the collar bones (clavicles) and the sternum (breast

[1] Appendix, Note 6.

bone). When the head is fixed in the upright position, these sterno-cleido-mastoid muscles, pulling equally on both sides, tend to lift the chest and hold it up in place. If the chest be held firmly in a good position, these muscles might act in just the opposite direction and pull the neck forward. If the neck be drawn forward in this manner, however, it almost invariably results in such a relaxation of these sterno-cleido muscles that the chest droops downward also in a collapsed or sunken position.

FIG. 24. — Forward slope of the neck in bad carriage of the head.

The shoulders are nearly always too far forward when the head and neck are thrust forward. Holding, as the shoulders do, the weight of the arms, a forward sag of the chest or back gives them the excuse for slipping forward in a yielding to gravitation for which they seem always in readiness.

In all this action and interaction of head, chest, and shoulders, one sees the working of the mechanical instinct for balance in the body. It matters not which is the first offender, — head, dorsal curve, or shoulders; as soon as one gets away from its balanced position in relation to the line of gravity, the others counterbalance it with a poor position also.

Several very potent causes besides this mechanical reaction

tend to pull the head forward. Defective sight and hearing are among those most frequently met. It is exceptional not to find need of correcting the head position of a child wearing glasses for nearsightedness or astigmatism, and weakness of both sight and hearing may often be first detected through this unconscious reaching forward of the head in an effort to help an imperfect sense. A sidewise tilting of the head, especially accompanied by squinting of the eyes, often accompanies astigmatism or other errors of refraction in the eyes, and should have the attention of an oculist.

Fig. 25. — A fashion plate.

Another possible cause of poor head positions has recently been suggested by Drs. Goldthwait and Brown.[1] They point out that much of the weight of the liver, stomach, and colon, attached as they are to the diaphragm, pulls on the neck through the fascia (tissues) that support the diaphragm from the cervical vertebræ. As the weight of the liver alone at fifteen years of age is 1420 grammes,[2] the significance of such a pull on the neck muscles becomes apparent, as well as the importance of maintaining a position of bones and ligaments so balanced that the strain shall not be thrown wholly upon the neck muscles.

Drs. Goldthwait and Brown, after describing the sagging out

[1] Goldthwait and Brown, 49. See also Baker, 3.

[2] Vierordt, 162.

of place of the viscera through the yielding of the cervical vertebræ in a poor position of the neck and head, say: —

"The writers feel that the full significance of the cervical fascia as the supporting ligament of the diaphragm, and consequently as part of the support of the abdominal viscera, has not been generally appreciated, and is consequently given special emphasis at this time. In the X-ray study of this subject it has been clearly shown that by merely changing the position from the droop to the erect position [of the neck], the position of the bottom of the stomach can be raised from one to two inches."

There is another position of the head, other than that induced by the neck, that is involved in correct carriage; namely, its tilt on the neck, which lifts or lowers the chin. In a quiescent standing position the general direction of the chin should be horizontal. The skull is so poised on the top of the spine that it very easily tips backward with the chin elevated in the air; on the contrary, a habit of casting down the eyes may lead to the opposite fault of depressing the chin. As temporary attitudes, there is no harm in either of these positions, but the habit of the erect position when that is assumed should be with the neck upright and the chin level.

In correcting the position of the neck and head, a clear distinction has to be made between drawing the neck backward so that it is an upright column, and merely tilting the head backward on the neck as just described.

The effect of the carriage of the neck and head on the total height of the body is very marked, and the impression created by their position is fully equal to that made by the posture of chest and spine. A well-poised head is one of the most beautiful points of a fine physique, and no factor is more important in the general impression of intelligence and efficiency unconsciously conveyed by the carriage of the body.

Sir Frederick Leighton

PLATE VIII. — "HIT."

CHAPTER VIII

THE CHEST

No part of the body undergoes in the process of growth greater changes in its proportions, shape, and contours than the chest, and for no part are the right lines of growth so often misunderstood.

The chest, or thorax, is that part of the trunk which is inclosed by the ribs and contains the heart and lungs (Fig. 26). It is separated from the abdomen by the great, flat breathing muscle, the diaphragm, which forms a distinct floor for it, though one that moves upward and downward with every breath. The ribs are attached behind to the dorsal spine, which holds them in a perfectly normal position when itself erect, with only its natural curve, but allows the ribs to sink downward in a collapsed position when the dorsal curve is increased or exaggerated. On the other hand, a backward tilt of the dorsal curve, as in the "bantam" attitude, fixes the ribs in an unnaturally distended position.

In front, the upper seven ribs are attached to the breast bone, or sternum, the next three each to the rib above it, and the last two are short so that they are mainly in the back and their outer ends are not attached to anything, from which fact they get the name of floating ribs. The collar bones (clavicles) lie across the top of the chest in front, being joined also to the sternum above the ribs. The clavicles are a part of the shoulder

girdle, and are not considered part of the chest, though their weight and position, and their attachment to the sternum, may help to depress or maintain the correct position of the chest.

The features in the chest, aside from its actual gain in girth, that undergo the greatest change during the years of growth, and that are most influenced by posture and other factors contributing to physical development, are (1) the proportion of depth to breadth; (2) the obliquity or slant of the ribs; (3) the obliquity of the sternum; and (4) the mobility, or extent to which the ribs move, in breathing.

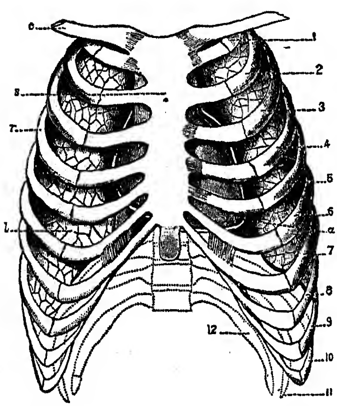


FIG. 26.—The thorax (chest) showing relation of ribs to heart and lungs. *c*, clavicle; *s*, sternum; *l*, lungs; *1*, *2*, *3*, etc., ribs.

The chest of an infant is very deep (from front to rear) in proportion to its breadth (from side to side). This gives the body a very round, compact form, as may be seen in Plates IV and IX. As a child grows older, this proportion changes, so that the breadth, measured with calipers from side to side under the arms, is much greater than the depth from sternum to spine. The effect of this is to make a broad, flat chest, comparatively thin through the body, and such a chest is rightly characteristic of children in the upper primary grades and from then on through adult life (see Plate VIII).[1]

Dr. Tyler remarks that "the flatness or hollowness of the chest

[1] Gray, 152; Dwight, in Piersol, 157, and other standard anatomies; Fitterholf and Gittings, 38; Hall, 55; Holt, 66; Hutchinson, 68, 69, 70, 71; Jaeger, 74; Oppenheim, 108; Rotch, 118; Sargent, 122; Trettien, 138; Tyler, 140; Whitman, 143; etc., etc.

of the boy or girl at ten or eleven, and its depth in the baby, are apparent to every one."[1] And Dr. G. Stanley Hall says; "As the thorax has flattened from front to back and broadened laterally as man became erect, a *change also marked from infancy to maturity, the adolescent chest growth is mainly lateral.*"[2]

Courtesy of Dr. Goldthwait

Fig. 27. — Typical tuberculosis chest, taken at random from a tuberculosis class.

There is a very persistent, popular idea that a good, full chest in a child or adult must be one that puffs largely outward and upward in front. No mistake could be greater; it is only the infant that has such a contour of chest, and in the development of a child, while the chest should gain in depth, every effort should be made to assist nature in establishing a chest that in its contours is broad and comparatively flat. Conversely, everything that tends to perpetuate the greater proportionate depth is a detriment and a mistake. Some of the worst deformities of the chest, such as pigeon breast, are exaggerations of the antero-posterior depth, while arrested development, preventing the broadening out or flattening of the chest, is found to exist in a majority of cases of tuberculosis,

[1] Tyler, 140, p. 67.

[2] *Adolescence*, 55, p. 69.

the interference with free respiration evidently being a predisposing cause.

Dr. Woods-Hutchinson, whose investigations on chest proportions have been of great significance, found that the typical consumptive chest, far from being flat in the sense of being thin from front to rear, is proportioned like the infant chest — thick in depth in relation to its breadth. This has been corroborated by numerous other investigators. The appearance of flatness in such cases comes from the collapsed posture, with the sliding forward of the shoulders, which always tends to make the chest look flat and narrow. Of the proportions "implied in the terms flat-chest, hollow chest, etc.," Dr. Hutchinson says: —

"The more carefully one inspects chests of this class, the more one is struck with the extent to which this flattening is apparent and not real. In the first place, even in popular terminology, 'flat-chestedness' is almost invariably associated with 'round shoulders.' In other words, the flattening of the anterior aspect [front] of the chest is in a very large measure due to the forward movement and carrying of the great muscular masses of the shoulder girdle. Our standard of flatness or fullness of chest is simply a line drawn across it from one acromion process [shoulder tip] to the other, and it is obvious that we may have a distinct flattening of this line with a decided round chest, provided that the shoulders be forward far enough. As is already suggested in the term round-shouldered, even a mere glance at the hollow chest will show us that a very large proportion of this anterior flattening is due to the gliding forward of the scapulæ [shoulder blades] and their attachments so that the posterior outline of the upper part of the chest wall [upper back under the shoulders], instead of being almost a straight line, as it should in the ideal position, is a very decided curve. And upon the application of accurate methods of measurements we find ourselves confronted with the surprising situation that our so-called flat chest is really, if anything, slightly above the normal in its antero-posterior diameter." [1]

[1] Hutchinson, 68.

As Dr. Hutchinson says, the typical tuberculosis chest, as regards these proportions, is "the persistent immature chest" — one that is too deep proportionately from front to rear.[1]

The relation of the antero-posterior measurement of the chest, or its depth, to the lateral measurement, or breadth, is called the chest index, and this is one of the most important points to be established in taking the physical measurements of an individual. Using the lateral measurement as the standard, and calling it 100, the antero-posterior measurement at birth is the same or a little greater; at seven years of age it is only about seventy per cent of the lateral diameter, and reaches its lowest index at from twelve to fourteen years of age, when it is only from sixty-two to sixty-five per cent. After this, the growth in depth seems to overtake somewhat the width, for the normal index in the adult is from seventy to seventy-two per cent.[2]

To quote from Dr. Woods-Hutchinson: —

> "At birth the diameters [of the chest] . . . are almost equal, while from this period up to the twelfth or thirteenth year, and to the twenty-fifth, even, there is a gradual, steady modification of the chest shape, until the full adult 'bellows' form is reached, in which the diameters are exactly reversed, viz., as two to three in favor of the transverse." And again, "In fact, almost incredible as it may seem, we have been misled by analogies drawn from the animal kingdom, and instead of the 'deep' human chest, that is, the chest with the long antero-posterior diameter being the type of vigor, it is just the reverse, and the *healthy, vigorous human chest is the broad, flat, well-expanded, low-indexed type.*"[3]

The contours of a child's chest change, then, from the prominent, rounded-out appearance of the very little child with short

[1] Woods-Hutchinson, 68, 69, 70; Evans, 36; Whitman, 143.
[2] Hutchinson, *Ibid.*; Dwight in Piersol, 157; Tyler, 140.
[3] Hutchinson, 69. See Appendix, Note 7.

neck (sometimes called the barrel-shaped chest) to the comparatively thin, flat-chested outlines of the boy and girl in the upper primary and the grammar grades (Figs. 28–29). The characteristics of chest and neck of a very young child help to place the age of the quaint little figure of the artist Strozzi's daughter in Titian's portrait in Plate XVIII.

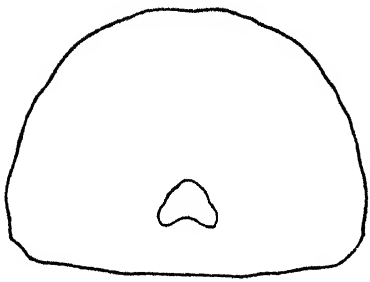


FIG. 28. — Outline of the chest of a child three years old, level of seventh dorsal vertebra. Note the great depth in proportion to breadth. (*After Dwight.*)

The age of greatest flat-chestedness (eleven to fifteen) is followed in the later high school years by one in which the chest appears slightly higher, — an appearance that probably comes from a greater protrusion of the sternum. This outward slope of the sternum

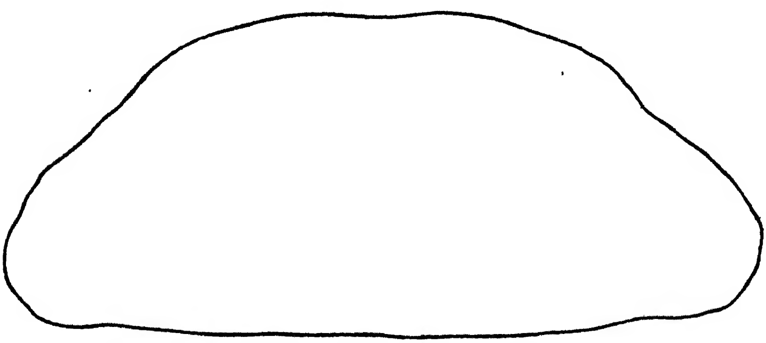


FIG. 29. — Outline of the chest of adult at level of sixth dorsal vertebra, showing how the chest has broadened and flattened from the round, deep proportions of the three-year-old child. (*Adapted from Braune and Bellamy.*)

should be kept through adult life (see Fig. 39); but here again it is necessary to add a word of caution against mistaking the moderate contours of the perfectly erect position

for an exaggerated lifting and puffing outward of the chest,— a position that may always be detected by the forced distention of the ribs, and the acccompanying lordosis (excessive hollow in the back).

Dr. Tyler remarks of the changed proportions at different ages: —

"The boy at twelve or thirteen, and the girl a year or two earlier, are farthest from the proportions of the infant. Adolescent and adult tend to return to the proportions of childhood. This is very clear in the relative length of trunk and legs, in girth of chest, and even more in its form and roundness."

The following conclusions of Dr. Hutchinson's indicate plainly the duty of physical education in the development of the chest in children: —

"1. The typical tuberculosis chest is round instead of flat and has an average index of about 80, nearly 10 degrees above the normal [*i.e.* the depth is 80 per cent of the width].

"2. This type of chest precedes the disease.

"3. It is an abnormal persistence of the fetal, infantile, and child type of chest.

"4. Any chest more than 18 years of age, which shows an index of 80 or higher should be regarded as abnormal and as rendering its possessor more than usually liable to tuberculosis.

"5. The occurrence of such a chest in any patient over 18 years of age, suspected of tuberculosis, raises a strong probability of the disease.

"6. The chests of growing boys and girls should be systematically measured at stated intervals, and whenever the index is found distinctly higher than normal for their age, active measures should be taken to remedy the defect.

"7. All those sports and exercises which involve wide swinging use and play of the arm, chest, and shoulder muscles, such as tree climbing, swinging from ladders, from rings, from bars, ball throwing [?], spear hurling, tennis, swimming, will tend to correct this defect and flatten the chest down to its normal width."

The change in the proportions and shape of the chest as it develops is accompanied by changes in the position of the ribs and sternum that need to be understood for correct ideas of development. In the infant most of the ribs, especially the upper seven, are nearly horizontal, coming practically straight around to the front from their attachment to the spine. As the child grows older, the sternum and the ribs sink, so that the ribs slope downward from the spine. The short, upper ribs, that make the opening, or base of the neck, sink down in front with the sternum, to which they are attached, the length of one or two vertebræ (as explained in discussing the head). This makes a longer throat line. The ribs below this (except the two little, straight floating ribs at the bottom) come to slope down very much more, so that they form a deep loop on the sides and are caught up again in front. This slant or loop is called the obliquity of the ribs and is very important, as it increases the capacity of the chest in breathing, and economizes the effort needed for its expansion, giving a much greater range of movement for the same amount of muscular work.

"The obliquity of the ribs adds greatly to their range of movement in respiration . . . and serves also the purpose of securing the necessary expansion of the chest with the least possible motion in the joints between the ribs and the spine, and between the cartilages of the ribs [*i.e.* their front or anterior ends] and the sternum. They are thus but little liable to strain, and, in spite of their unceasing movement during life, are very rarely the seat of either dislocation or disease." [1]

The infant with nearly horizontal ribs has to breathe from thirty-five to forty-four times per minute to supply his needs, while at fifteen years of age, the ribs being oblique, eighteen

[1] Piersol, 157.

Plate IX. — Boy with a Goose. Munich.

to twenty respirations per minute suffice. While numerous factors are involved in this change in respiration, the obliquity of the ribs is significant.

Finally, the breast bone, or sternum, undergoes marked changes in position during the years of growth. In the infant it protrudes at an angle much nearer to a horizontal plane than later. In the child of the intermediate and upper elementary school it subsides to much nearer a vertical position, making the chest appear flat. In the adult, it would seem that the sternum comes to slope outward a little more, though never again so much as in the infant, for the adult chest index rises to its normal seventy per cent from the sixty-two of the child's period of very flat chest; but even at its deepest, the contours of the adult chest are never those of the "chesty" attitude. Always, the broad chest is more valuable than the proportionately deep one.

The application of these points of development to posture is of primary importance, for the proper development can be most obviously helped or hindered by habitual positions. In relaxed attitudes, where the back bows out and sinks backward and the chest is depressed, the functional activity of the ribs in breathing is plainly interfered with. Dr. Kellogg says on this point: —

"In having a round-shouldered, flat-chested person breathe into a spirometer after a full breath, I have found the lung capacity to be only 270 [cubic inches]; whereas the same person standing in a proper position was able to expel 310 inches after taking a full inspiration, an increase of fifteen per cent.

"The involuntary inspiration must be interfered with [in poor posture] to an even greater extent. The person breathing in a stooped position is constantly in a state of air starvation, —a fact which is evidenced by the disposition to straighten up and draw a long, deep

breath every now and then, which is constantly noticed in persons who sit at study or work in a stooped attitude."[1]

Obviously, for full, normal lung action, a proper position of the chest is of primary importance. A collapsed, shrinking attitude of the chest is characteristic of weak or diseased lungs. The subject shown in Fig. 27 was selected at random from a tuberculosis class. The posture is the same as that of the fatigue position.

FIG. 30.—Abnormal protrusion of the chest from overcorrection — the "bantam" attitude.

It remains to consider the effect on chest development of the exaggerated posture that comes from overexertion — the abnormal protrusion of the chest shown in the "bantam" attitude (Fig. 30). The effect of this is to return the ribs and sternum toward the horizontal position, instead of allowing them to subside into the oblique positions that are an inevitable part of the broadening out of the chest in a normal, natural development. Obviously, this exaggerated lifting or protrusion continues the immature proportions, encouraging the depth from sternum to spine instead of the width of a natural, healthful chest. In other words, this attitude, whether assumed temporarily as an

[1] Kellogg, 81.

exercise, or cultivated as an habitual standing position, tends to foster the "persistent immature chest" which Dr. Woods-Hutchinson found to be typical of tuberculosis.

The interference of this abnormal position with the movements of breathing is at once apparent. It has already been explained that the obliquity of the ribs favors their fuller movement in respiration, and such an influence as this position, which negatives the obliquity, can but tell unfavorably on the mobility of the chest walls in normal respiration. Moreover, in this exaggerated attitude the ribs are fixed in a distended position with what is called static contraction of the muscles. The extent to which the chest expands in respiration — its enlargement and contraction with each breath — is of greater importance for the full and healthful functioning of the lungs than its simple girth. This expansion is a point of more importance with life insurance companies, in judging the physical condition of applicants for policies, than the extent to which the chest can be fixed in its largest possible attitude.

Fothergill found that rigidity of chest, or lack of flexibility and expansion in the movements of breathing, was a concomitant of tuberculosis of the lungs, and others have corroborated this.[1]

That the overcorrected type of posture cultivates rigidity of the chest, and interferes with free, normal respiration, has been forcibly pointed out.[2]

It will be seen that girth of chest, a measurement taken with a tape straight around under the arms, cannot indicate whether or not the chest is broad or deep, or is held in good position. Chest girth, however, is one of the most important considerations in development, as, taken in proportion to total height, it is an indication of the relative size and power of the important organs

[1] Hutchinson, 68.

[2] See Sargent, 122; Hall, 55.

within. After the nineteenth year the chest girth should be equal to half the height.[1] The effect of posture on trunk capacity was discussed in connection with the spine. It may not, however, be amiss to reiterate that only a chest in the normal position can give full room for the growth and functioning of the organs contained in the thoracic cavity. When the weight of these organs is thrust, by collapsed posture, upon the abdominal organs below, the ill effects naturally extend to those organs also.

The following table of proportions in trunk capacity (sitting height and chest girth and index) should be prefaced with a word of explanation as to the general principles that govern the judging of an individual by such figures. The modern trend in applying physical measurements is to compare an individual with an elastic standard and not wholly with some arbitrary external type. That is, instead of saying that a child of a certain age should have a certain girth of chest, it is found more reliable to say that a child of a given age and height should have a chest girth that comes within certain maximum and minimum measurements, which are found to be compatible with normal growth and and health. For among a number of children of the same age, the height may vary greatly, and with it the girth and other measurements. Some, in other words, may be of a tall, thin type, and others of a short and stocky build, both of which types may be perfectly normal. It should therefore be understood that the figures given are for those found in the greatest number measured at the age mentioned, and that a moderate variation would not be abnormal.

Another point in the use of measurements that is of much value is the comparison of an individual with himself by estimating the relative proportion of different parts. The illumi-

[1] Hall (G. S.), 55; Hall (W. S.), 57; Tyler, 140; Chaille, 17.

Table Showing Relative Trunk Proportions and Chest Index[1]

Age	Height		Sitting Height		Sitting Height Percentage of Total Height		Chest Girth		Chest Girth Percentage of Total Height		Chest Breadth		Chest Depth		Chest Index: Depth Divided by Breadth		Age
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
0	52.5	52.2					34.2	33.2	65.1	63.6							
1	73.8	73.2					45.9	44.4	62.2	60.6							
2	82.8	82.8					48.4	47.0	58.5	56.8							
3	89.1	89.1					51.1	50.5	57.4	56.7							
4	96.7	96.7					52.8	52.2	54.6	54.0							
5	106.0	105.3					54.8	53.5	51.7	50.8	17.88	17.58	12.36	12.51	69.13	71.16	5
6	108.9	107.7	61.3	59.5	56.3	55.2	59.1	58.3	54.2	54.1	18.64	17.53	12.84	12.37	68.88	70.56	6
7	114.0	113.0	63.3	61.8	55.5	54.7	60.6	59.5	53.1	52.7	19.06	18.34	13.07	12.62	68.57	68.81	7
8	119.1	118.4	64.7	64.0	54.3	54.0	62.8	60.8	52.7	51.3	19.72	19.04	12.95	12.66	65.62	66.49	8
9	124.4	123.7	66.7	66.2	53.6	53.5	63.9	62.5	51.3	50.5	19.72	19.37	13.30	12.91	67.44	66.65	9
10	128.9	128.4	69.3	68.2	53.7	53.1	65.6	63.0	50.9	49.0	20.30	20.63	13.32	13.48	65.61	65.33	10
11	133.8	133.2	70.7	70.0	52.8	52.6	67.2	65.9	50.2	49.4	20.97	20.35	13.77	13.13	65.66	64.52	11
12	138.2	139.1	72.6	72.7	52.5	52.2	68.8	68.3	49.8	49.1	21.76	21.20	14.40	13.56	66.17	64.00	12
13	142.9	146.5	74.2	76.0	51.9	51.9	70.6	71.3	49.4	48.6	22.40	22.35	14.90	14.18	66.50	64.00	13
14	148.6	150.8	76.8	78.7	51.7	52.2	73.3	74.1	49.3	49.1	22.75	22.58	14.90	14.52	65.49	64.30	14
15	154.9	155.0	79.7	81.4	51.5	52.5	76.6	76.8	49.4	49.5	23.63	24.00	15.80	15.18	66.86	62.92	15
16	160.3	157.5	82.3	83.8	51.3	53.2	79.2	78.9	49.3	50.1	24.66	23.93	16.20	15.90	65.69	66.44	16
17	165.1	159.3	85.7	84.7	51.9	53.2	81.4	80.4	49.3	50.5	25.48	24.47	17.97	17.01	70.52	69.59	17
18	170.4	159.4	88.2	85.2	51.7	53.4	84.5	80.5	49.6	50.5	25.51	24.45	18.29	17.04	71.69	69.69	18

[1] Measurements are in centimeters. To transpose to inches, multiply by .393. Most of the figures in this table are used by courtesy of Dr. John Mason Tyler. They are based on measurements by Porter and Holt (height, sitting height, and chest girth) and Hastings (depth and breadth of chest). For normal variations for the different age heights (measurements, not comparative percentages) see Hastings, 63. The normal chest index for adults, Dr. Woods-Hutchinson found (as the result of several thousand measurements) to be 71 per cent. He considers variations under 80 per cent as normal, but above that distinctly abnormal.

nating significance of this has already been shown in connection with the chest index and proportionate size of the trunk.

To sum up, the natural, healthful development of the chest is in the direction of proportionate increase in breadth rather than depth. While the depth should increase with growth, a proportionately flat, broad chest is better than a high, protruding chest, which, if it persist beyond early childhood, should be as much a cause for anxiety as the collapsed, depressed chest of the relaxed attitude. When the upper part of the spine is held erect, so that the general axis of the trunk makes one continuous vertical line (according to the vertical line test described in Chapter II), the chest will be in a perfectly normal position. An appearance of flatness or narrowness may often be caused by a forward position of the shoulders, and as such a shoulder position may depress and contract the chest by giving it too much weight to support, it becomes important that the shoulders be in a correct position.[1]

In all consideration of the chest, it should be borne in mind that the correct development and posture of the bony cage that contains the lungs is only one factor, however important, in lung development. Lung capacity is not synonymous with chest capacity, for one may have a large chest containing weak lungs or very limited respiratory movements. Healthful lung tissue, generously used through the demands of the system for oxygen, together with a well-established power and habit of action in the respiratory muscles, are essentials of a good physique. To enhance the physiological action of the lungs through exercise and the stimulus of cold, fresh air, is a feature of lung development essential to any scheme of physical training. The present study, being confined to the subject of posture only, cannot enter upon that field.

[1] See Appendix, Note 7.

Vandyke

PLATE X. — WILLIAM II, PRINCE OF NASSAU.

CHAPTER IX

THE SHOULDERS

The arms are each attached to two bones — the clavicle, or collar bone, in front, and the scapula, or shoulder blade, behind. These four bones are called the shoulder girdle. This shoulder girdle is fastened to the trunk by only one bony joint, where the clavicles join the sternum in front. This sterno-clavicular joint, with its two little sharp prominences, is what makes the bony protrusion in a thin neck at the base of the throat. The scapulæ, in the back, have no bony attachment whatever to the trunk, being entirely dependent for their position on the good tone and elasticity of muscles that draw them backward toward the spine, and inward, close to the chest wall and flat upon it. When one considers that nearly all occupations with the hands or arms are in front of the body, drawing the shoulders forward, it is not surprising that the posterior or back muscles, which antagonize this forward action and hold the shoulder blades in place, are kept unduly stretched, so that they lose their tone and allow the shoulders to droop forward. If, in addition to this, the spine be bowed over with an exaggerated curve in the dorsal region, the shoulders naturally slip forward still more, yielding to the pull of gravitation.

Dr. Woods-Hutchinson found that with chests of round or barrel shape, which had not gained sufficiently in breadth, and had too great a proportionate depth, the shoulders were out of place, probably because of the rounded shape of the chest walls,

which allowed them to slide forward as they could not do on a broad chest, flattened behind. The appearance of flat-chestedness in consumptives, he found, came from this forward position of the shoulders and not from the actual conformation of the chest which proved, on measurement, to be fuller in depth in such cases than it should be in normal development. Dr. Hutchinson says: —

"Briefly stated, flatness of the chest is merely an index of the position of the shoulders. Your flat-chested [tuberculous] individual is almost invariably round shouldered, and if you will simply take the trouble to . . . pull the shoulders back into something like their normal dorsal position, you will at once see, on looking down the front of the chest, that the actual shape of the rib-cage is rounded and barrel-like. Indeed, it is this very shape which has given rise to the abnormal position of the shoulders."

With due allowance for other causes of forward shoulders, and for the voluntary protrusion of the chest that often comes from overcorrection before a child has learned to isolate the action of the shoulder muscles, this description applies to many non-tuberculous cases also.

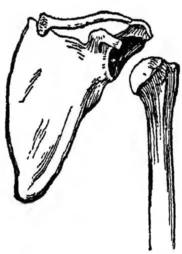


FIG. 31. — Shoulder blade seen from the front, with clavicle (collar bone) and top of humerus (upper arm bone).

It will be seen that the action and position of the shoulder girdle, while it may be influenced by the position of the spine, may also be entirely independent of it. In studying posture in large numbers of children, this becomes very apparent, for it is not unusual to find a child who can hold the spine perfectly erect, and who is nevertheless decidedly round-shouldered. Just what, then, is the correct position of the shoulders, and what are round shoulders?

Obviously, the correct position for the shoulders, carrying as they do the weight of the arms, is one in which they are so balanced in relation to the line of gravity, that their tendency will be to tip the trunk neither forward nor backward. Authorities seem perfectly agreed that this position is well back of the line of gravity. This is plainly shown in the cut from Dr. Lovett's work (Fig. 9). Dr. Goldthwait says: —

"The shoulder is slightly back of the lateral median line of the body, so that the weight is received largely upon the thorax, none of the muscles being in more than slight contraction, and the strain upon the posterior muscles, which must occur when the shoulder is held forward, is absent."[1] And again, the "center [of the shoulders] is distinctly posterior to the center of gravity."[2]

In the quadruped the scapulæ are much farther around on the sides of the chest walls (that is, toward the front or sternum) than in man, and their backward position, assumed with the erect attitude, has given a much wider range of movement for the arms at the shoulder joint. Their correct position in relation to the chest is, then, one in which they have this range of movement.

In the very little child with the barrel-shaped chest (*i.e.* up to four years of age) the shoulder blades, then very small in size, are often more on the sides of the chest, as in the quadruped. As the chest broadens out, it gets flatter in the back as well as in front, and the scapulæ, by this time growing rapidly so that they are much longer, should swing around on the back until they lie flat upon the rear wall of the chest,[3] as shown in Fig. 20.

In a very large percentage of cases, probably from the very

[1] Goldthwait, 48.

[2] *Ibid.*

[3] Woods-Hutchinson, 68, 69; Trettien, 138; Goldthwait, 48.

slight amount of exercise given the posterior muscles, this shifting of the scapulæ until they lie flat on the back fails to take place, and as a result the shoulder blades lie obliquely on the sides of the chest, protruding behind in a deformity known as wing shoulder blades (*scapulæ alatæ*) (Fig. 32). This gives the appearance of a high, bowed-over back, even when the spine is not at all involved. The protruding point of the scapulæ (inferior angle) may be easily felt behind, and in marked cases is plainly visible, even through the clothing. At the same time the outer tip or round of the shoulder is forced forward so that there is an unnaturally deep hollow on the front between the tip of the shoulder and the neck. The harm of this oblique or forward position of the shoulder blade lies, as before intimated, in the fact that the weight of the arms and the entire shoulder girdle is thrust too far forward, tending to drag the chest downward and prevent free action in breathing. When the shoulders are in this forward position, in order to keep the mechanical balance of the body the dorsal spine tends to bow outward behind in a curve greater than normal (kyphosis), the upper part of the trunk sinking backward with it. In this way the spine and chest are liable to participate in the faulty shoulder position, even if they have not been its cause.

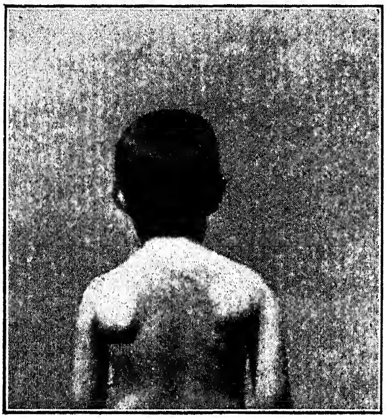


Fig. 32.—Wing shoulder blades on a child of six years of age.

A forward carriage of the shoulders has, in many cases, been found a cause of acute pain in the shoulder and arm, similar to

that of neuritis and writer's cramp, and often hard to distinguish from those ailments. The position leads to unnatural pressure on nerves, bursæ, and other parts, acute inflammation and distress resulting. Cases of repeated dislocation of the shoulder joint have also been traced to such malposition. In a detailed study of such conditions Dr. Goldthwait found that the correct (flat) position of the shoulder blades on the back was the one that gave greatest stability to the shoulder joint, holding the various parts most evenly to their proper relation to each other. The drooping position with the shoulders forward he found to be the one of greatest instability as regards the parts and tissues around the joint, and from this instability arises the pressures and pain referred to above.[1]

The correct position of the shoulder blades, then, may be determined by their flatness on the back, which carries the outer round or tip of the shoulder back of the median line of the body. The shoulders are placed in a balanced position by stretching the arms directly sidewise (not backward). Without this arm action, their position is often concealed by the clothing, and in studying several hundred cases to find an external landmark that could be readily used as a guide to detect an extreme forward position of the shoulders, the author found that in every case in which the trunk, *including the neck*, was perfectly upright, and the scapulæ flat on the back, the round of the shoulder came under, and, in a few cases, back of, the ear. This ear test has proved to be a thoroughly practicable criterion, readily used by any layman. Restated from a previous chapter, this test means that a line drawn upward through the middle of the round or tip of the shoulder should fall within, or back of, the ear. This is very readily demonstrated by placing the

[1] Goldthwait, 51.

outer edge of the hand on the shoulder, with the fingers pointing toward the same point on the opposite shoulder, and toward the head, so as to show the relation of the shoulder to the ear. This is illustrated in Fig. 33. This test for a balanced position of the shoulders appears valid at all ages, even during the period of the cylindrical or barrel-shaped chest, for the author found it true in two hundred cases of children ranging from six months to seven years of age, and no exceptions have been found in many thousands of cases of older children. Stated differently, this ear test means that no normal shoulder blade can be flat on the back if the shoulder tip is in front of the forward border of the ear. That it is back of that border does not necessarily mean that the shoulder blades are in a perfect position and not in need of any special help, but where the clothing, as of school children, conceals the

FIG. 33. — How to make the ear test for correct position of the round of the shoulder.

position, one may be sure of a faulty position from the ear landmark. This ear test should not be confused with the vertical line test for the entire body, from which it is entirely distinct: for a line showing the relation between the ear and the shoulder tip is to the rear of the weight line, falling from in front of the ear to the forward part of the foot.

Forward shoulders, with the wing protrusion behind, occur in so large a number of children that it would seem beyond question advisable to forestall this fault of posture by definite exercise of the posterior muscles that counteract it. This will be discussed more at length with the means of correcting posture in general. The author feels, however, that the position of the shoulder blades is one of the most salient indications that definite education and training for erect posture are needed for every child, entirely irrespective of correction in cases that have gone astray in the growing-up process. The trouble should be forestalled and prevented rather than corrected.

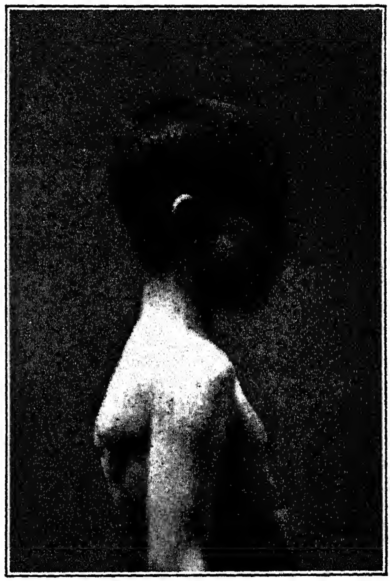


Fig. 34.—Wing shoulder blades seen from the side.

Forward or round shoulders fall into two classes, like spinal curvature: the first, which may be called postural, being a condition which the child can voluntarily correct by contracting the muscles that draw the shoulder blades together; the second,

which is called resistant, or structural, forward shoulders, being a condition in which the shoulder blades cannot be put or held in position either by the child himself or by another. Cases of resistant forward shoulders are not very numerous, but among a large number of children are occasionally met with, and the orthopedic surgeon is not infrequently called upon to remedy such a defect. In such cases it is found that some of the ligaments around the shoulder joint may be too short, or the clavicle too short, or the scapulæ themselves may have grown rounded over the top, or be otherwise peculiar in structure.[1]

The chief cause, however, of resistant forward shoulders was found by Dr. Fitz,[2] in an extended series of clinical and anatomical investigations, to be an abnormal shortness in the serratus magnus muscle — a large muscle attached to the under side of the shoulder blade and then to the sides of the chest under the arms. The general direction of this muscle from the scapula is downward and forward, and its chief action is to pull the scapula (shoulder) forward. It does the main work in pulling the arm forward to deliver the ball in a throwing movement. Previous to Dr. Fitz' investigations, it had been supposed that the large muscles on the front of the chest, the pectorals, were responsible for this forward position of the shoulder blades, but there seems little doubt that the serratus is mainly at fault.

The treatment for resistant forward shoulders may vary from the use of braces or other means of stretching the muscles and ligaments by holding the shoulders in position, to surgical aid. In any event, with both structural and postural round shoulders, the muscles that antagonize the serratus and draw the scapulæ toward each other and inward toward the spine (mainly the rhomboideus major and minor and the trapezius) need to be strength-

[1] Goldthwait, 51, 53, 54; Taylor, 133. [2] Fitz, 40.

ened by what are called shoulder-blade exercises. Without such exercise it is not reasonable to expect correction of even the postural cases in which the child has the power to voluntarily retract the shoulder blades. Until the muscles have been systematically trained to maintain the position, such a movement on his part is only the result of a temporary nervous stimulus.

To ascertain the prevalence of resistant forward shoulders in very young children, and their possible relation to failure of the scapulæ to swing around on to the back with the change in chest contours, the author examined the shoulders of one hundred and forty-eight children in the kindergarten and first year of the primary grades, ranging in age from five to seven years. The flexibility of the shoulders was tested by placing them in position with the hands, as shown in Fig. 48. If, being out of place to start with, they could be put in position, and if they could then be held there and voluntarily put there by the child, the shoulders were called flexible — *i.e.* non-resistant. Out of one hundred and forty-eight children examined, only four cases were found in which this could not be done, — four cases, that is, of resistant forward shoulders. That muscular training is needed to insure right shoulder positions, even with these very little people, was apparent from the fact that not infrequently the muscular tension holding the shoulders forward was so great (whether habitual or assumed during the examination could not always be determined) that some tact, and occasionally a gymnastic exercise with the arms, was necessary to get the needed relaxation. In these strong tension cases, however, if the right position was finally acquired so that it could be voluntarily assumed, the case was tabulated as one of flexible shoulders.

Mr. Trettien's investigation of changes in chest contours and shoulder-blade positions in infants is of much interest, and shows on both topics the general tendency toward normal development even at this early age.[1]

The literature on shoulder development is so scanty that it was a surprise, in a study of children for the prominence of the shoulder blades, to find almost invariably a more or less decided prominence of the scapulæ in children from five to seven years of age (see Fig. 32), and the same fact in very mild form in a few cases of four-year-old children. By "prominent" is meant, in this particular study of two hundred children, any protrusion of the inferior angle of the scapulæ, however slight. Only part of this number were prominent enough to be classed as wing shoulder blades, though that this defect may be found in young children is apparent from the six-year-old subject in Fig. 32. Only when the scapulæ reached the size and oblique position of the wing shoulder blades did the tip of the shoulder lie in front of the ear.

From these facts it appears that the natural growth in length of the scapulæ, while the chest is still in the cylindrical form, may lead directly into wing shoulder blades if the posterior muscles are not trained during this early period of growth. At the same time the serratus magnus muscle, which draws the shoulders forward, should be stretched with wide, swinging movements of the arms similar to those that Dr. Hutchinson recommends for widening the chest.

There is probably no line of development in which the policy to be pursued in physical training is more clearly indicated by the facts of growth than this of the correct position of the shoulders. Such factors as changes in the shape of the chest wall, accompany-

[1] Trettien, 138.

TABULATED STUDY OF PROMINENT, FLEXIBLE, AND RESISTANT SHOULDER BLADES IN YOUNG CHILDREN

Number of Cases			Age	Shoulder Blades						Shoulders					
				Prominent			Not Prominent			Flexible			Resistant		
Boys	Girls	Total		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
		10	Under 2 years			0			10						
		17	2 years			0			17						
		20	3 years			0			20						
7	3	10	4 years	7	2	9		1	1	7	3	10			
36	31	67	5 years	33	30	63	3	1	4	30	30	60	1	1	2*
44	28	72	6 years	43	23	66	1	5	6	43	27	70	1	1	2
4		4	7 years	3		3	1		1	4		4			
91	62	200		86	55	141	5	7	59	84	60	144	2	2	4

Ninety-five per cent of the boys from 4 to 7 years of age had prominent shoulder blades.
Eighty-nine per cent of the girls from 4 to 6 years of age, had prominent shoulder blades.
* Five cases not examined for flexibility of shoulders.

ing changes in the position of the shoulder blades, the need of increased tension in posterior muscles as the shoulder blades undergo their rapid growth in length, and possible peculiarities in the structure of the shoulder joint and serratus muscles, all indicate the need for systematic training for all children. This training may well begin, even in the kindergarten and lower primary grades, with a large amount of the imitation plays and games in which the arms are stretched sidewise as wings, waving branches, walking beams, teeter boards, etc., and the first primary year is none too early for beginning straight, sidewise stretching movements of the arms at shoulder level, in formal gymnastic exercise.

In training for correct position of the shoulders, the strength and tone of posterior muscles, the muscular sense of correct position, and correct muscular habits are, as in all other phases of posture, of fundamental importance. The fact that the poor position may be voluntarily corrected has led to an occasional opinion that the fault is due entirely to laziness and may be corrected by an exertion of will power. Though it is true that will power may do much, the question remains, as with any other phase of poor posture, — Why the need for will power? Why do not all children grow correctly as some do? When we can answer such questions in regard to mental and moral development, we may be able to answer them for these phases of physical development. Meanwhile, systematic training for the posterior muscles, and the cultivation of the right sense and habit of posture, can eliminate a large percentage of the postural cases, and possibly forestall many cases of resistant round shoulders.

A word of caution is advisable against telling a child to "throw his shoulders back." There never was a more misleading and

harmful direction for correct position. It results almost invariably in a throwing backward of the entire upper part of the trunk — one of the worst faults in bad carriage of the body. Practically every child can learn to draw his shoulder blades together, and that is what is really wanted and what he should be told to do.

Every authority on the subject recognizes that round shoulders are not an isolated fault of posture. Like every other such fault, they act both as cause and effect, and "involve the whole body, from the base of support to the head."

The restriction of breathing movements in child or adult by the forward carriage of the arms is in itself a final argument for correct position of the shoulders. "I am convinced," says Dr. Hutchinson, "that one of the most important factors in the respiratory development and capacity of the human chest is the extent to which the scapulæ come to lie upon the posterior wall."

The idea that a child will spontaneously outgrow round shoulders is not tenable. One has only to watch the army of young people passing out of our elementary schools, through the high schools, and entering higher institutions with round shoulders and protruding scapulæ to see the fallacy of that idea The number of adults whose poise, energy, and health are reduced by poor posture, are in themselves a sufficient proof of the harm of leaving to the chances of growth so important a matter.

CHAPTER X

THE PELVIS, ABDOMEN, AND FEET

THE pelvis has been called the bony floor of the trunk of the body, and such seems to be its service. It is a large, irregular circle, or girdle, somewhat like an open basin, to which the legs are attached, and the top of which forms the hip bones at the sides. It is attached to the spine at the sacrum, just below the last lumbar vertebra, so closely that it is tilted or moved with changes in the lumbar curve. Naturally, it acts in the opposite way, any change in the tilt of the pelvis affecting the curves of the spine (see Fig. 12).

In its natural position the pelvis is tilted considerably downward and forward, but serves, nevertheless, as a very substantial support for the organs above it. When this obliquity is increased, the support is withdrawn, and an unnatural strain to keep the pelvic and abdominal organs in place is thrown upon the abdominal walls and also upon the ligaments that help to suspend those organs in place. Fully as harmful — perhaps even more so — is the result of tilting the pelvis in the opposite direction, with the posterior rim depressed and the anterior, or front rim, raised. This brings it into a horizontal position, in which the direction of the weight of the heavy abdominal organs above bears directly downward upon the pelvic organs. Dr. Goldthwait lays particular stress upon the harm of this position in both men and women. It is a position that comes from, or is associated with, the obliteration of the lumbar

Proctor

PLATE XI. — INDIAN WARRIOR.

curve in the second type of bad posture described in Chapter II ("straight back"), and it forms one of the most pronounced faults of bad sitting positions, sometimes due as much to ill-shaped or ill-fitting furniture as to the fault of the sitter.

The obliquity of the pelvis may also be influenced by relaxation or overtension of the muscles that hold it upright on the thighs. It will be remembered that in the assumption of the erect position from that of "all fours," the pelvis was drawn up into its right relation to the thighs by muscles on the back of the buttocks and thighs (the glutei and hamstrings). This muscular action is complicated by the fact that the powerful hamstrings, which run along the back of the thighs, are two-joint muscles; that is, instead of passing over just one point as do the majority of muscles, bending only that joint (the bend of the elbow by the biceps is a good illustration of a one-joint muscle), they pass over both the knee and hip joints so that relaxation or hyperextension of the knees may affect the tilt of the pelvis.

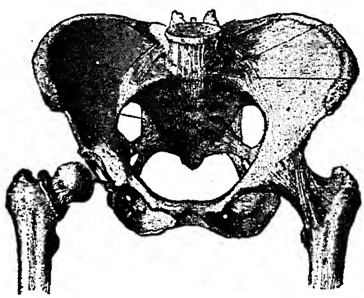


FIG. 35.—The pelvis, or "bony floor" of the trunk; also upper part of the femur (thigh bone).

Here we have at once another center of complicated action and interaction, quite equal to that of the spine itself, and, indeed, so closely related to it that weak muscles at the knees or abdomen, by affecting the tilt of the pelvis, tell at once on the curves of the spine and so on the posture of the whole trunk of the body. Here again, also, overtension is as bad as relaxation. The knees sprung backward too tensely may throw the hips back too far, exaggerating the lumbar curve and tilting the pelvis

downward too far in front. This is a very difficult fault to correct, and one not infrequently met with in children (Fig. 36). The hamstrings at the knees, and some powerful muscles in the front of the pelvis that pull its front rim downward toward the thighs (the psoas and iliacus group), participate in this over-extension and have to be relaxed to correct it. The position may nearly always be detected by an abnormal, sharp protrusion of the buttocks behind, and an exaggeration of the lumbar curve, so marked that it seems more an angle than a curve. A sidewise tilt of the pelvis, acquired through a habit of standing on one foot, is also extremely injurious.[1]

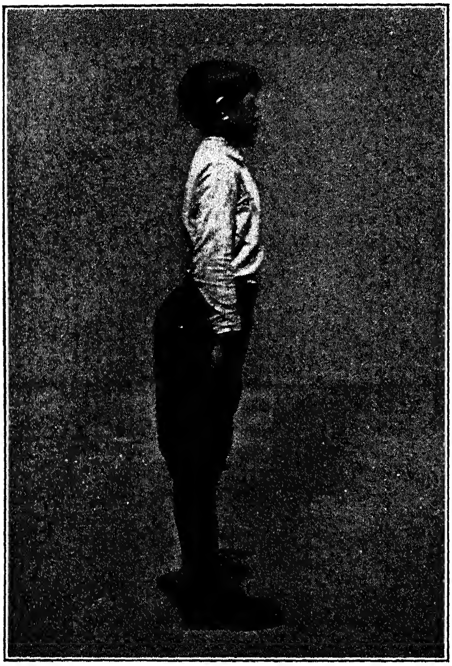


Fig. 36. — The pelvis tilted too much by springing the knees and buttocks (hips) backward. Note the sharp angle in the hollow of the back.

The abdominal muscles, involving, as they do, the position of chest, spine, and pelvis, have a great deal to do with good posture. The abdominal region, which, as regards its musculature, includes the front and sides of the trunk below the ribs, has no bones to support it in the way the ribs inclose the chest. Its walls are entirely of muscle in many layers, passing over the trunk vertically, horizontally, and obliquely in both directions, —

[1] Mosher, 99, 100, 101, 102.

a wonderful structure with as many directions to its strands as the most expert weaver could devise to give elasticity and strength to a textile on the loom. If these muscles are in good, elastic tone from proper use and exercise, they make a firm wall that helps to hold in place the great organs of the trunk; if allowed to become flabby and relaxed, however, or if drawn out of shape by improper dressing, these abdominal muscles, having no bony framework to reënforce them, fail to support the organs within and allow them to sag out of place. The correct contours of the abdomen and the front of the body will be discussed in considering the subject of dress; suffice it to say here that there is nothing of greater importance for the posture of the body, for the position of the organs of the trunk, for the circulation of the blood through those organs, or for other general conditions that make for their proper functioning, than strong abdominal walls. There is no part of the body that suffers more from the relaxation of prolonged or poor sitting positions, or from the distortion of dress. There is none for which systematic, daily exercise is more needed.[1]

And finally — and there is no reason except that of beginning with the most obvious elements, why they should not have been mentioned first — finally we come to the feet, the base of support of the whole structure. The feet have a posture of their own to be considered, in addition to the exact place in them that should bear the weight line of the body.

A generation ago children were taught to turn their toes outward, and for a majority of people a straight forward direction of the foot was equivalent to "toeing in." The distinction is not as generally understood to-day as it should be, though the the prevalence of flat foot (broken or fallen arches) — one of

[1] Harvey, 62.

the results of excessive toeing out — is leading to a painful awakening on the subject. From fifty-seven to sixty-one per cent of the cases of flat foot are found between the ages of ten and twenty-five, the larger number of these being between sixteen and twenty-five,[1] which shows that young people need especial care for the hygiene of the foot during the time when the neuro-muscular system is immature, and weight is rapidly increased.

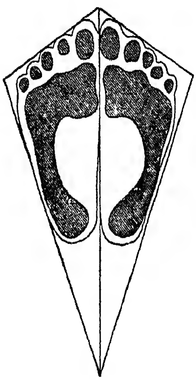


FIG. 37. — Normal impress of adult foot and normal outline as inclosed in geometric boundaries. (*From Whitman's "Orthopedic Surgery," by courtesy of Messrs. Lea & Febiger.*)

The normal foot has a natural arch in its structure, between the heel and the ball, which shows as a hollow on the inner side. After a child is six years old (and usually before) an impress of the bare foot on the ground shows that the hollow does not touch the surface (Fig. 37). When the toes are turned broadly outward, the ligaments that hold this arch up are put under such a strain that in a very large number of cases they yield, allowing the inner hollow to flatten out so that it touches the ground. This condition may also be detected by the ankle joint on the inner side which, in flat foot, becomes unduly prominent, for the weight of the body is thrown too far inward, instead of bearing directly downward through the center of the heel. This condition of broken arch is a very painful one, its effects often not being confined to the region of the foot, but involving strain upon the ligaments throughout the leg. This condition of flat foot is pathological, like lateral curvature of the spine, and should as promptly have medical diagnosis and treatment. The

[1] Whitman, 143.

wearing of arches or supports may be part of the treatment required, but the correction of wrong habits of muscular action in the habitual position of the foot, and the strength-

FIG. 38.—The correct position of the foot in walking and standing is with the toes pointed straight forward.

ening of weak muscles by gymnastic exercise, are also indicated.

The correct position of the foot in walking or standing is

with the toes pointing straight forward [1] (Fig. 38). This is the position in which the two natural arches — that from front to rear, and the lateral arch from side to side — have proper support from the heel and the ball of the foot, or from ligaments or other surfaces. So placed, these arches can perform their full function without undue strain. This straight-foot position is the one in which Indians perform their great endurance feats of running and walking, and it is also characteristic of our best athletic runners. In this position the foot has its greatest elasticity, and can bear the weight longest without fatigue in standing, running, or walking. Dr. Ochsner observes, "I have watched very carefully and so far have never come across a patient suffering from flat foot who habitually stood and walked with his feet nearly parallel." [2]

With flat foot, and the extreme out-toeing positions that accompany or lead to it, the knees and hips are apt to be relaxed, so that the tilt of the pelvis and the curves of the spine above may all be influenced by the posture of the feet.

It is customary in gymnastic training to have the weight of the body placed over the balls of the feet. Such instruction is necessary with a great many people to avoid carrying the weight too far backward over the heels — a position that throws the whole body out of plumb, and sacrifices that elasticity of the foot that saves jar in walking. On the exact point in the foot where the line of gravity should fall, authorities differ, and it may vary somewhat with the build of the individual. In this, as in judging the erectness of the trunk, the eye very readily learns to discriminate between a perfectly erect attitude and one that gives an impression of falling forward. In standing, the heels should always rest firmly on the ground and bear part of the

[1] Taylor, 132, 133; Rotch, 118; Ochsner, 106, etc.

[2] Ochsner, 106.

weight; at the same time one should be able to feel that the ball of the foot is pressing firmly upon the ground. Many people carry the weight too far backward, and directions for swaying the body forward *from the ankle* are necessary in almost all cases of postural correction.

CHAPTER XI

POSTURE IN ADULTS

To stand erect means fully as much for the health and efficiency of an adult as it does for a child. The effects are quite the same as regards the functioning of the organs, their possible displacement, or the expenditure of energy required for maintaining the erect position. Indeed, it may mean even more, when endurance comes to be taxed by the demands of adult interests and occupations.

Whether or not a person be standing in the correct position may be judged for the adult, as for the child, most simply and directly by the vertical line test. Re-stated, that means that a vertical line dropped from in front of the ear into the forward part of the foot should parallel the apparent vertical axis or diameter of the trunk, and of the neck and head taken together. In poor standing of the relaxed types — the types most often met with — the axis of head and neck form one line which slopes downward and backward, the apparent axis of the trunk another, which slopes downward and forward, and a third direction is necessary to carry the line down into the forward part of the feet. In the correct position, the shoulders should be set squarely across the back, so that they are flat and the shoulder blades do not protrude. A vertical line drawn upward through the round of the shoulder should fall within the ear or behind it, the exact point varying in different individuals. The hollow in the back should not be excessive, — a fault that may be detected,

Gainsborough

PLATE XII. — THE MORNING WALK. SQUIRE HALLETT AND HIS WIFE.
(*From the collection of Lord Rothschild. By courtesy of Braun and Co.*)

according to its cause, by a forced distention of the ribs and puffing out of the chest in front, a stiff arching backward of the buttocks behind, or a sagging backward of the upper part of the trunk. This latter fault cannot occur when the axis of the whole trunk is vertical. The feet should have the toes directed straight ahead, and the weight should fall on the middle or forward part of the foot.

The normal chest in an adult is much broader (from side to side) than it is deep (from front to rear), the index, or proportion of depth to breadth, being from seventy to seventy-two per cent. The girth of chest after nineteen years of age should be, according to competent authorities, about half the height — certainly not less. The terms "full chest" and "high chest" do not mean that depth should exceed breadth, or that there should be more than moderate slope outward of the sternum. This slope of the sternum is slightly greater in adults than in children of eleven to fifteen years of age, but never forced outward by a muscular tension that sets the ribs, or tips the trunk backward. The simple movement of bringing the upper part of the trunk forward so that the chest is over the toes, puts the spine and chest in the correct position. The term "chest high," then, means, for a naturally developed chest, simply, chest not collapsed. One looks in vain through Greek statuary for the strained, puffed-out chest of the exaggerated attitude. Greek gods and heroes, no matter in what moment of action or relaxation they may be depicted, have the broad, flat chest, with the moderate outward slope of the sternum — never the "chesty" exaggeration that correct attitude is sometimes interpreted to mean. Indeed, all of the points that have been given in foregoing chapters for the correct carriage of chest, head, shoulders, and other details, are amply illustrated in Greek statuary.

Wrestlers, warriors, and gods, quiescent or active, all show the flat shoulder blades on the back, and the perfect development and relation of parts that mean good posture. A Venus with wing shoulder blades, or an Apollo with puffed-out chest, can be found only in the sketches of the modern cartoonist. In a study of statuary in the Early Greek room of the Boston Museum of Fine Arts, which contains casts from 500–600 B.C., and includes an age of high Spartan development, Dr. Goldthwait found there was not a single cast or reproduction that did not show the body so poised that the greatest efficiency of the organism would be possible. Of Fig. 39 he says:—

Courtesy of Dr. Goldthwait

FIG. 39.—Correct standing position in a Greek statue of the period of highest Spartan development.

"While the modeling may not equal that of the later Greek period, the poise is all that could be desired. The head is erect and in such balance that all of the muscles must be in easy contraction, making possible any movement, forward, backward, sidewise, or with any combination, with the greatest ease and with the least possible waste of energy. The chest is high, allowing the fullest freedom of action of the thoracic organs. The shoulders are erect, in which position all of the muscles are in easy contraction ready for immediate function with the least effort. The trunk is so in balance that no group of

muscles or part is strained, but action with the minimum of waste is possible, while the visceral support and function is maintained with the least effort. So, also, with the legs, there is no strain, but every part is ready for full duty with the least waste in either time or energy. The greatest amount of general fitness is suggested by the figure, and this applies not only to that which is physical, but to the spirit or the purpose of the individual. In every part, the body, the mind, and the spirit, the figure suggests readiness and efficiency."

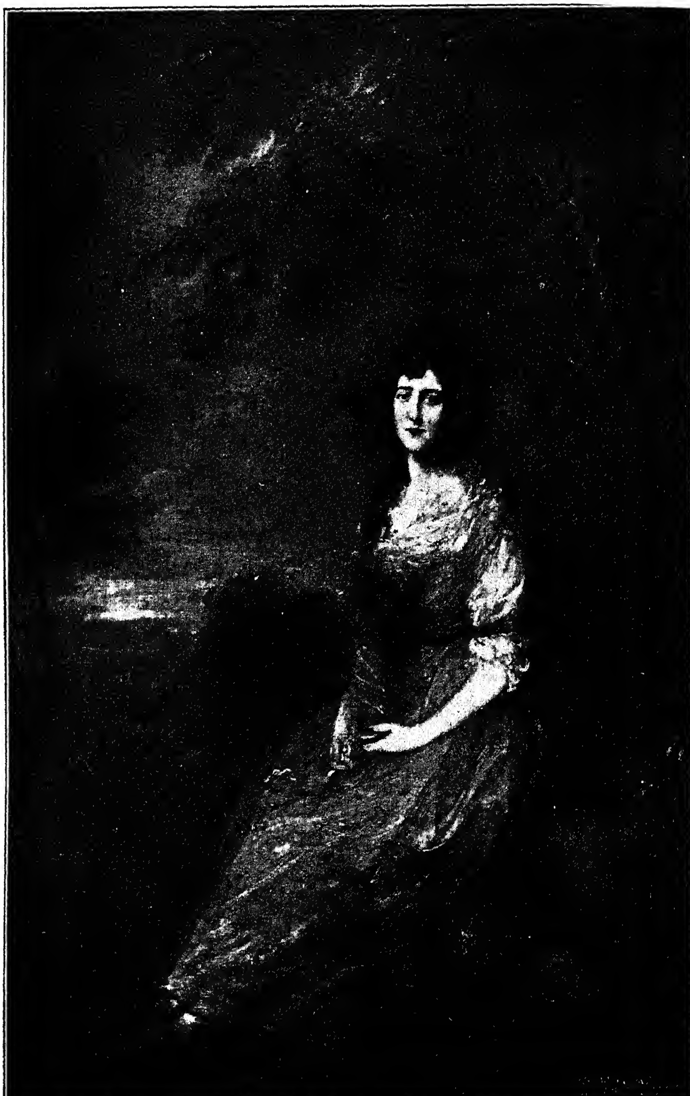
Notice that the vertical line test applies perfectly to this entire figure, as does also the ear test for the position of the shoulders. It is noticeable, too, that, as in all Greek statues, the perfectly erect position does not call for static distention of the ribs. No strain of this kind appears in any part of the figure, although the "high" chest has a slope of sternum of thirty degrees, five degrees above the maximum normal for an adult, which would be excessive for a child during the natural "flat-chested" age.

The term "flat back" is sometimes used to indicate a desirable contour for the back, but never, by an expert, in the sense of obliterating the natural curves. Like the "chest high," this term so used means a back either flat over the shoulders, or showing only a normal hollow in the lumbar region as distinguished from the exaggeration of lordosis.

Good posture in child or adult means the relation of parts in *habitual* attitudes. No one should maintain an absolutely erect position during all the waking hours, even if the ordinary occupations of life allow it. But whenever the erect attitude is assumed, for standing, walking, or sitting, whether the hands or eyes be actively engaged or not, the body should conform to the vertical line test. Temporary changes of position are not only advisable but necessary, for the good tone of the muscles that hold the body erect may be maintained only by such relief and variations in their

activity. Nothing is more subversive of good habits of posture than long standing, and any one whose occupation calls for this should vary the base of support by the standing positions described for recitation in school work on page 261.

Habitual positions, whether required by one's occupation or assumed as an unconscious habit, are what mold the body and become ingrained in the muscular sense, confirming or vitiating the natural sense of bodily equilibrium. These habits require study and correction if wrong, or continued cultivation if right. Fatigue comes less readily in correct posture, and the energy spent through unconscious muscular action in maintaining a bad position is available in good posture, for other uses. In good posture, also, better circulation, respiration, and digestion keep the stores of energy and sense of well-being at a higher level, and the efficiency and even the spirits of the individual are thereby placed on a loftier plane.



Gainsborough

PLATE XIII. — MRS. SHERIDAN.
(By courtesy of Braun and Co.)

CHAPTER XII

ERECT POSTURE IN SITTING, STANDING, WALKING, AND STAIR CLIMBING

UNDER the conditions of our modern civilization, the average person, whether child or adult, spends more hours a day in sitting than in standing or walking. The carriage of the body becomes, therefore, as important in sitting as in any other attitude, and all that affects its posture and the consequent position of the viscera holds as truly in a sitting position as in standing.

There are three correct modes of sitting, two active and the other resting. In the active positions the trunk is perfectly erect, or inclined forward; in the resting position it is reclined backward. Many people make the mistake of including in the act of sitting a relaxation or collapsing of the body forward, with a crease at the waist. The interference which such an attitude makes with the position and work of heart, lungs, and digestive organs is anything but restful, — a fact shown by the relief that comes from occasionally stretching upward to the right position and drawing in a long breath, — the indication of "air starvation" noted by Dr. Kellogg.

A fundamental direction for correct sitting is to push back in the chair as far as possible before leaning backward. Sliding down in the seat tilts the pelvis into its most harmful position, and should never be allowed.

All leaning forward in a sitting position, as in formal conversation or at the dining table, should be from the hips, not

from the waist. A perfect sitting position of this kind is shown in the attitude of Mrs. Sheridan, in Gainsborough's famous portrait (Plate XIII). Both of these sitting positions — the leaning forward and the perfectly erect attitude — require the same work of most of the muscles that hold the spine erect that is needed of them in the standing position, except that much of the pull of gravitation is removed in sitting because the center of gravity is closer to the base of support (the chair). The uncertainty of equilibrium is also less in sitting than in standing, owing to the wider support afforded by the pelvis as compared to the feet. The relief of sitting comes not only through releasing the strain of the voluntary muscles that hold the body upright, but also through the lessened demand on the heart, which does not have to send the blood climbing through so long a distance against gravitation as in standing.

When one wishes to rest the muscles that hold the trunk erect in the sitting position, the entire trunk should be reclined backward against the back of the chair or other support. This accomplishes the object without any interference with the broad, open chest if the chair back be of the right shape. This reclining should be done without sliding downward and forward in the seat.

The height and shape of chairs has much to do with sitting positions. It is impossible in many to assume good posture. The chair should be of such height that the feet may rest fully on the floor. The lines that affect the back are also of great importance. These are discussed with home and school hygiene.

Sitting on one foot is a habit with many girls, which, if habitual, may produce lateral curvature of the spine.

Prolonged standing is one of the most fatiguing things that can be required. Walking is far less fatiguing, and within

reasonable limits has an exhilarating effect, for the muscles are kept alternately contracting and stretching, and the circulation is more or less stimulated. In prolonged standing, on the other hand, muscles, ligaments, and heart are all put on an unrelieved strain that may lead to permanent weakening unless all possible means be taken to avoid such a result. Broken or weakened arches in the feet are most common among policemen, car drivers, and others who have much static standing; these and all other faults of posture are found abundantly among shop girls and others whose vocations call for long standing. Instinctive methods of relief consist mainly in shifting the weight and position as much as possible. But out of this is apt to grow a habit of standing too much on the same foot, especially with a sidewise inclination, which is one of the worst faults that comes from prolonged standing. Relief should be found in the positions illustrated by Dr. Mosher, and explained in the chapter on school hygiene.

Housework, with its comparatively slight moving about, is almost equivalent to standing, and the result of it is quite the same, a very considerable percentage of cases of flat foot coming from houseworkers.[1]

The habit of boys of standing and walking with hands in the pockets leads usually into a slouching position of the worst posture, especially if the pockets be deep (Fig. 40). Relief from weight of the arms may much better be had from catching the fingers in the belt, than from putting the hands in the pockets.

Walking is one of the best of exercises if the dress be such as to allow proper freedom of motion. It is correct for the heel to touch the ground first, but if the weight be poised well forward, it will be transferred very quickly to the ball of the

[1] Woods-Hutchinson, 72.

foot, so that the placing of the foot seems almost flat-footed. When the weight is not poised well forward, the heel comes down with such force that the elasticity of the step is largely lost, being replaced by a harmful jar that is transmitted throughout the body. Such a backward carriage of the weight means inevitably that pelvis and spine are not in right relation to each other.

Courtesy of Dr. Goldthwait

FIG. 40. — The slouching position cultivated by carrying the hands in the pockets.

The idea that in walking the toes should touch the ground first is one of the fallacies that has grown from the wearing of high-heeled shoes; with these there is no alternative to such an artificial use of the foot. A dainty and elegant use of the foot avoids thrusting the toes noticeably upward when the foot is extended for a step in walking, but they should not touch the ground first. The toes should point directly forward in the "straight-foot" position.

A perfectly erect carriage of the trunk of the body is one of the essentials of graceful as well as healthful walking. There must always be some mechanical reaction to the movement of the foot and leg,[1] as in the slight swing of the arms at the sides

[1] Marey, 95; Pettigrew, 110; Schafer, 159.

(never across the front of the body). This reaction is greater the longer the step, as may be seen in the swing of body or arms in certain forms of skating. If this movement of the arms be restrained, the reaction will show in some twist of shoulders or hips. These matters will take care of themselves if the poise and dress be correct, and with those two elements right, practice in the mere act of walking in long, interesting walks in which there is no thought of detailed movements, is the best teacher of grace.

Stair climbing, both as to its methods and effects, is one of those common activities about which cling many traditional fallacies. Stair climbing may be an excellent exercise, stimulating to good circulation and deep breathing. To any one in normal health it can do no harm *if not carried to excess.* The point of departure comes when the tax upon the heart is excessive, and for this reason the climbing of many flights of stairs many times a day should be avoided, even for a person in normal condition. A reasonable amount of stair climbing, however, may be looked upon as good exercise for those in normal health, *if the erect posture be maintained throughout.* This is the essential point in stair climbing (Fig. 41). The lifting of the whole weight of the body by the large muscles of the legs and thighs will stimulate heart and lung action very quickly. This is an inevitable physiological consequence — a perfectly natural result — and, indeed, the effect that makes stair climbing a good exercise. If the trunk be bent forward at the waist, however, in any of the cramped or collapsed positions of poor posture, the action of heart and lungs is quickly embarrassed, and distress and undue fatigue at the time and afterward are the result. There should, therefore, be an erect carriage of the trunk as a fundamental requisite to stair climbing. Even with this posture, an extended

climb will result in a quickening of the breath. Any one not burdened with excessive flesh should be in such good condition (training) that at least one flight of stairs could be climbed

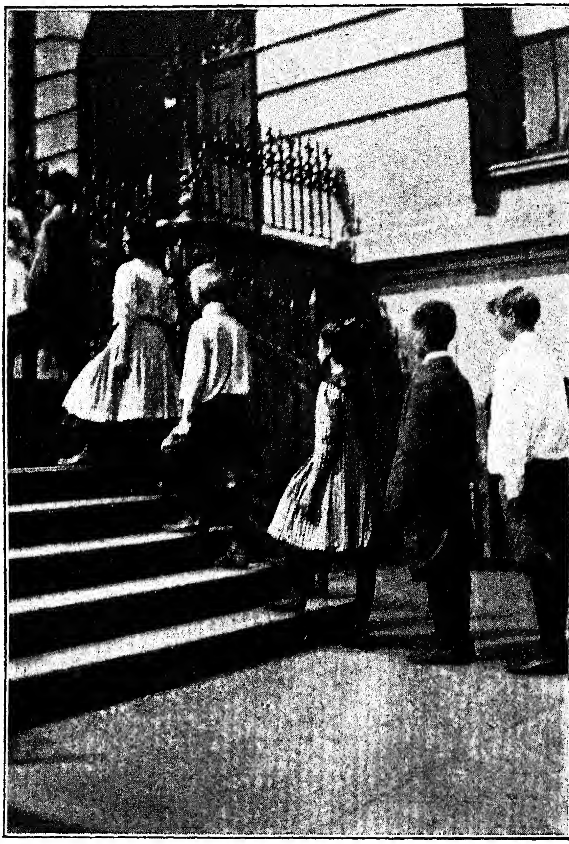


FIG. 41. — Erect carriage of the body in stair climbing.

without noticeable embarrassment of respiration. When the climbing of several flights is necessary, one should not hesitate to stand or sit and rest a moment in transit.

The way in which the foot is placed upon the stairs is a matter that usually takes care of itself instinctively. This is another

of the subjects of traditional dogmatism, and, like all traditions, is subject to many variations. The truth is, that the mechanics of stair climbing have not received as much technical study as the mechanics of standing and walking, but the most salient features are obvious. Mounting a flight of stairs means carrying the body in two directions — upward and forward. If the depth of each step (from front to rear) be slight, there is very little need for a forward tilt of the body. If it be great, there is the same need for tilting the body forward that there is in a long step in walking. This tilt should be from the ankles as in walking, or from the hips, and never from the waist. If the step be very high or deep, or the climber very heavy, the leverage on the forward knee may need to be eased by a forward tip of the body from the hips — here again, never from the waist. Whether the whole foot should be planted on the advance step or not is a matter that may well be left to instinct, for this, too, may vary with the height and depth of the step and the weight of the individual. In descending stairs, however, the toe should touch first, so as to lessen the work of the "hold back" muscles, and save jar to the body.

Finally, it should be remembered that no position, sitting, standing, or lying down, should be maintained long without change of attitude. This applies to both children and adults, but especially to children, whose natural restlessness is one of the fundamental instincts of nature to secure for them the motor activity and the relief from strain that have a deep physiological and educational significance. The climbing instinct of very little children is a part of this, and should be respected and provided for, as was done some time ago in the invention of a "climbing high chair." It is not meant that children should make themselves disagreeable, or fail of control through indul-

gence in restlessness, but that an undue suppression of it is a positive harm and even cruelty to the child.

Good posture, then, does not mean one unvarying attitude held through all the waking hours. It means the *habitual* carriage, and especially that when the body is in the erect attitude it shall be truly erect. Transitory twisting and turning, stooping and bending, if not long maintained, but only for temporary relief, are nature's own way of relieving the strain of man's last and proudest achievement, erect carriage of the body.

Titian

Plate XIV. — A Daughter of the Artist Strozzi.

CHAPTER XIII

HOW TO CORRECT POOR POSTURE: WHAT MAY BE DONE AT HOME; TRAINING THE MUSCULAR SENSE

NAGGING is the worst possible way of correcting posture; and yet from time immemorial it has been a method to which almost every child whose posture has had attention has been subjected. The foregoing chapters have failed of their purpose if they have not made plain that nothing could be more unjust or even cruel to a child than to expect him to correct, solely by spasmodic effort of his will, faults incidental to the shape, weaknesses, and development of his body in the process of growth. Systematic training, especially designed to cultivate the right contours, to strengthen weak muscles, and to establish correct neuromuscular habits, is the only proper way of achieving correct posture; and, more than that, it is the only effective way of reënforcing and training the will power that he must exert to establish the right habits.

The word "systematic" is the keynote in this training, and because of its organized opportunity for systematic work, and the appeal which it can make to individual and class pride and ambition, the school has a great opportunity for such training. As in all other lines of school work, however, the coöperation of the home is essential if the best results are to be obtained. For cases needing correction, this help may well lie in the direction of additional home exercise, and some regular method of encouraging the positions which the school is trying to establish. Certainly, the efforts the school is making in these directions

should be clearly understood by parents, and followed up by them in any way suggested through coöperation with the school authorities. Probably the greatest need that the school finds for help from the home is on the side of hygiene, including matters of dress, conditions for home study, proper amount of sleep, nutrition, and home tasks, and other matters that will be dwelt upon in the chapter on home hygiene. Methods of correcting posture at home will be outlined in the present chapter.

First of all in the correction of posture comes the training of the muscular sense of the correct position. By this is meant literally how it feels to stand correctly. Usually we are not conscious of the sense of position, but without going into any of the subtleties of discussions on the matter it may be said at once that there exists a subconscious sense of the position of the different parts of the body, and also a distinct instinct for equilibrium. The little child, learning to stand erect for the first time, is largely helped by these powers, though at that time they are weak and undeveloped. The sense of equilibrium, which controls his muscular adjustments, leads unconsciously in all of his movements and activities to the mechanical reactions, whereby the line of gravity is kept within the base of support and the body is saved from falling. Reference has been made to changes in the natural curves of the spine whereby a change of position in one part is counterbalanced by changes in other parts. Dr. Lovett also attributes to this sense of equilibrium the establishment of many lateral curves of the spine, especially those that are usually called secondary or compensatory curves, which show an instinctive effort to keep the shoulders and pelvis parallel with each other when one or the other is thrown out of position.

The habitual position in which the body maintains the erect attitude, whether the posture be good or poor, becomes ingrained, as it were, in the nervous system, so that a habit is established of associating that particular combination of muscular tension with the erect position. To use a familiar simile, the muscles become molded to this particular shape, just as a glove becomes molded to the shape of the hand, and maintains the form when all conscious influence is withdrawn. It feels right to stand in this habitual posture, and to change to a new posture, however much that may release cramped breathing movements and improve the position and action of the organs, will seem strange and unnatural. This feeling of position comes from the muscles in whole or in part, and the first step in correcting posture is to train discrimination in this feeling — this muscular sense of position — so that the person concerned will know by this feeling alone whether or not he is in the correct position, and will be able to assume it at will.

Some children can place themselves in correct posture by following a few simple directions, but in many children the muscular power and control for this voluntary correction are at first lacking, and it is necessary that they be placed in position by some one else with what are called manual corrections until the voluntary power be acquired. The best and simplest method which the author has found for getting the first-mentioned class of children into correct standing position, is to have them stretch the arms directly sidewise at shoulder level, with the palms turned downward, and, holding the arms there, sway forward from the ankles so that the weight of the boy is nearly or quite over the balls of the feet, not, however, rising on the toes, but keeping the heels on the ground (Fig. 42). An effort to draw the neck backward (chin inward) may be necessary to bring the neck

into an upright position. Keeping head, chest, and shoulders just as this places them, the arms should then be dropped to the sides. This will leave the entire body in the correct standing position. The advantage of this method is that it is synthetic, treating the body as a whole by taking advantage of the natural mechanical reactions whereby, if the upper part of the trunk be placed in position, by swaying the weight forward and stretching the arms sidewise, the rest falls naturally into line. This has been found much more easily to accomplish the purpose than the analytic methods often used which call attention to details entirely, such as "Head up, chin in, chest out, hips back, weight forward." While a child may well know these points, it is very difficult for him to isolate the action of different parts of the body called for by such analytic directions. Especially for different sections of the trunk, as chest, hips, abdomen, etc., the habitual association of muscular groups is such that they will act together synthetically; whereas, if the different parts be corrected separately, all sorts of difficulties of adjustment will be encountered.

FIG. 42. — Stretching the arms sidewise and swaying forward from the ankles to get in good position. (*From Bancroft's "School Gymnastics, Free Hand," by courtesy of Messrs. D. C. Heath & Co.*)

If a child's own motor facility be not sufficient to achieve the correct position in the way described, he may be placed in posi-

tion with assistance. For this, the first and chief point of attack is the upper part of the trunk, which in all relaxed types of poor posture will be found to have sunk backward. The problem in all correction of this fault is to get this part forward without forcing the ribs and sternum forward and outward in the

FIG. 43.—The hands placed for pushing the upper part of the trunk forward.

FIG. 44.—The corrected position of the trunk.

exaggerated "bantam" attitude — an overcorrection into which a child without muscular facility is very apt to fall, especially if he try to correct his position unaided. In assisting a child into position, the spine needs to be treated as though it had but one joint, and that in the small of the back (lumbar curve),

— the point where weakness has allowed the settling backward. To accomplish the correction, one should stand at the child's side, so as to see him in profile, and place one hand just below the belt in front to serve as a steadying point of resistance; with the other hand back of the shoulders behind, the upper part of the trunk should be pushed forward (Figs. 43, 44). When this is done, the spinal curves (with the possible exception of the neck), the chest, and the pelvis will all fall into correct position. This whole movement really amounts to bringing the chest forward, but the method of doing it confines the action chiefly to the spine, and avoids the artificial distention of the ribs that comes from efforts to lift the chest or protrude it forward.

FIG. 45. — Getting a child to relax distended ribs.

A distention of the ribs requires an entirely different method of correction. This fault comes from too much effort — too much tension in the muscles — and should be corrected by relaxation. To place one's hands on the distended ribs and ask the child to "Relax," or to "Let go," or not to "Try so hard," will usually

accomplish this (Fig. 45). Overextension may always be detected by an extreme hollow in the back, and whenever such a fault is found, it should be corrected as just described.

If the head (neck) cannot be placed in position with a voluntary effort, the chin should be pushed inward as shown in Fig. 46; this will be found to straighten the neck. Some children lack entirely at first the power to retract voluntarily the neck in this way.

FIG. 46. — Pushing the chin inward to correct a forward slope of the neck.

The shoulders may still need some assistance to get them into the correct position. Judging these by the ear test and other indications described in Chapter II, if the shoulders be found too far forward, and the lower angle of them protruding behind, the cases will be very rare in which they may not easily be drawn into place by standing behind the child and placing the hands as shown in Fig. 48. The thumbs are spread out over the back and serve to give the slight purchase needed to draw the shoulder blades inward toward the spine. Here again the child will probably be able at once to hold the position without help, and to lose and resume it himself. Because of the close association of muscular action involved in this movement of the shoulder blades and the overexten-

sion of the spine, this shoulder movement is sometimes accompanied with the exaggerated posture before noted. With some tact and patience the two movements (of shoulder blades and spine) may be isolated, and the correct position of shoulders assumed without overdoing the attitude of spine and ribs.

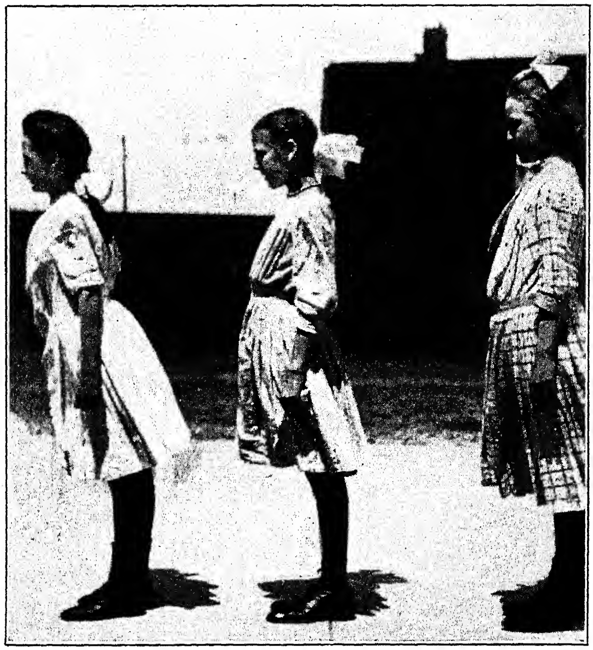


FIG. 47.—Improper posture: on the left, overcorrection by swaying too far forward; center and right, relaxed poor posture.

Having acquired the correct position, the child should learn through a little drill to lose and assume it voluntarily. This he should be asked to do in a deliberate manner, with no effort at haste, for in very rapid action his movements are not only inclined to be less accurate, but he will be less likely to discriminate carefully between the feeling of the old and the new positions. Later, he can take this posture drill quickly on signals.

If, after relaxing into the old habitual position, he cannot resume accurately the corrected position, he should again be helped into it. This drill on losing and resuming the good position should be repeated several times in succession. It is the foundation for any further work, and too much cannot be said of its importance. There is no use in trying to strengthen any weak muscles connected with poor posture unless the child can assume this correct position as a basis for exercising them, for otherwise the old habits of coordination assert themselves during the performance of the exercise, and its corrective effects are lost. With some children patient help in assuming the right position is needed on successive days, but most children will acquire in a few minutes the power to put themselves in position.

FIG. 48.—How to place the hands for drawing the shoulder blades backward into position.

Two faults may need to be guarded against in this correction of position — a bending forward at the waist or hips instead

of swaying forward from the ankles, and the overcorrection with fixed and distended ribs, which cultivates lordosis (exaggerated lumbar curve). If there be any tendency to bend forward at the waist or hips, instead of swaying forward from the ankles, it may at once be overcome by asking that the whole body be kept firm as though in one piece, with no joints except at the feet as the weight is swayed forward. Sometimes the stretching sidewise of the arms will also help to overcome this tendency to bend forward at the waist or hips.

With such a power of voluntarily assuming the correct position, however transitory may be the ability to hold it, one has a foundation on which to rear a structure of strong muscles and the habit of their proper coördination in any of the activities of life. Without this power, any such training is worse than useless; it serves only to accentuate and to cultivate the old faults.

To remind a child of the correct position at times is usually necessary, but on the way in which that reminder is given will depend its being a mere irritating nagging or a true training. By systematic association with certain times and places, such reminders may recall him to the correct position with sufficient frequency to form a habit *if, meanwhile, the weak muscles be properly trained to do their part.* In the discussion of school training for posture there are described methods of establishing habits of posture, under school conditions, that have substituted motive on the part of the child for the old, ineffectual nagging, that was as distasteful to the teacher as to himself. For home use the writer would suggest that the assumption of the correct posture be made a part of certain, regular procedures, — for instance, of dressing in the morning. An old Civil War general was in the habit of having his children line up for inspection of their toilets before sitting down to breakfast. In true military

fashion he passed them in review, each saluting as he passed down the line — a half playful element of ceremonial that made almost a game of this inspection of finger nails, hair, neckties, shoes, and other details of dress. Any one found lacking in these requirements was obliged to make good the deficiency before coming to breakfast. In this happy but serious manner, all nagging was done away with, and a systematic method substituted.

The suggestion is one that might be applied in various ways to the assumption of correct posture. Starting for school, for instance, might well be an occasion for inspection of posture, as well as of toilet, especially if books are to be carried. The habit of always getting into good position when leaving the house is one easily acquired. As in everything else, it is the repeated doing that leads ultimately to the established usage.

CHAPTER XIV

HOW TO CORRECT POOR POSTURE: HOME EXERCISE

WHENEVER posture is habitually poor, there are weak muscles failing to do the work necessary to hold the body erect. By an effort of the will these muscles may be contracted for a brief period, as described in the last chapter, so that the position is temporarily corrected; but such momentary activity will not be sufficient to permanently improve their tone (strength, elasticity, and habitual tension). Such tone can come only through their repeated alternate contraction and relaxation in gymnastic exercise especially designed to call them into play. This type of gymnastic work is known as corrective exercise. These same muscles may act, to be sure, in other kinds of exercise, — in playing tennis, for instance. In such use, however, because the attention is occupied on external matters, their old habit of coördination with other muscles is continued, with the result that those habits are even more firmly fixed and the poor posture is confirmed instead of altered. To change these habits of coördination, or relative tension between different muscle groups, conscious effort must be made to that end, and corrective exercises, taken with definite effort, *are the only means of achieving the result.* It is because of its failure to cultivate muscular strength that the "nagging" method of correcting posture fails, and works the greatest injustice to the child, for it throws upon spasmodic nervous effort work that only strong muscle fibers can sustain.

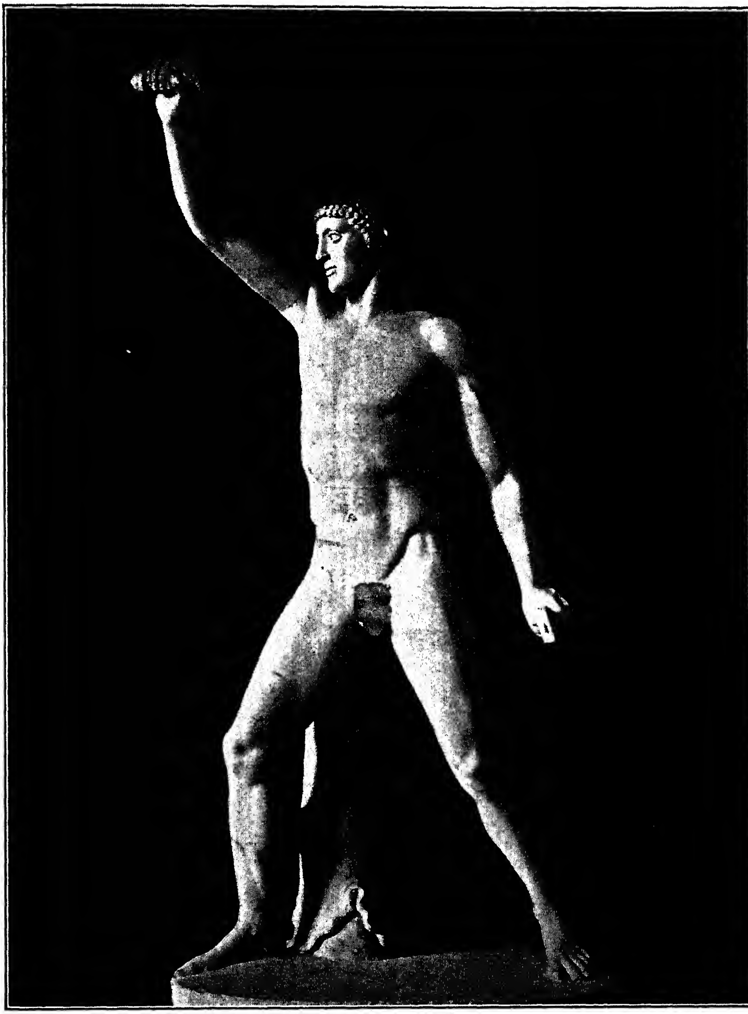


Plate XV.—Aristogeton. Noysel Bourbon Museum.

In selecting exercises to be done at home for the correction of posture, the individual needs of each case should be considered. It is desirable in any scheme of exercise to avoid monotony, that interest may be kept alive, and with it greater energy for the movements. This may be done by occasionally adding or substituting new elements, but in this place the subject cannot be gone into in such progressive detail; a few exercises, however, that have been found needed by, and effective for, many thousands of children, are described. For nervous or delicate children of elementary school age, who are having systematic corrective exercise in school, the first three exercises may be found enough for daily use at home, if their faults of posture are those indicated.

As a preliminary to any exercise, the correct standing position should be taken, and it should be held throughout. At the close of each exercise (or before the full number of counts be finished, if there be signs of fatigue), the good standing position should be relaxed for a few moments to relieve any tiresome muscular tension, and then resumed before going on with the movements. Too much stress cannot be laid upon this assumption of the correct position as a preliminary. *Without it, corrective exercises do not correct*, but only aggravate every fault of posture; with it, they not only give the right direction and pull to particular muscles, but associate different groups in the right proportion, so that exact muscle tension and habits for maintaining the correct position are established.

Assuming, then, that the body is placed in correct posture to start with, and that this is maintained throughout except for intentional intervals of relaxation, the following exercises will be found useful for strengthening the muscles that are weak in faulty position of the parts indicated:—

1. **FOR CORRECTING THE POSITION OF THE SHOULDER BLADES.** — Swing the arms forward to shoulder level and bend the elbows so as to bring the finger tips to the top of the shoulders, with the elbows pointing forward (Fig. 49). This is the starting position, and the fingers remain on the shoulders throughout this particular exercise. From this position, lift the elbows and describe with them a semicircle at the sides, upward, backward, and downward (Fig. 50). This closing position should leave the upper arms close at the sides and should contract the muscles that draw the shoulder blades close together; that is, inward toward the spine and flat upon the back.

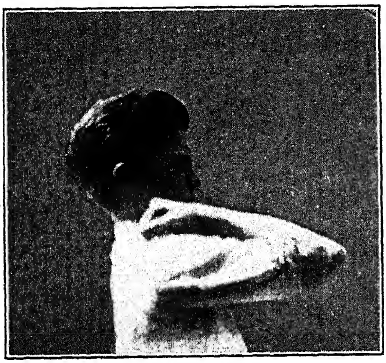


FIG. 49. — Starting position for the shoulder blade exercise.

Take the movement deliberately, then swing the elbows directly to the front again, the finger tips remaining on the shoulders, and repeat the upward, backward, and downward motion of the elbows, describing with them a semicircle in one continuous movement.

A tendency to thrust the head forward as the shoulder blades draw together, as well as a tendency to let the upper part of the trunk sink backward, will have to be firmly resisted (Fig. 51). To avoid these faults of execution, keep the upper part of the trunk well forward, with the chest over the toes, and the chin drawn inward. The opposite fault of hollowing the back too much and thrusting the ribs and sternum too far forward will also have to be avoided. The objects of the exercise are (1)

to strengthen the muscles that hold the shoulder blades in position, and (2) to isolate the action of these muscles from others of the trunk, — a control that is usually accomplished with comparative facility through this exercise.

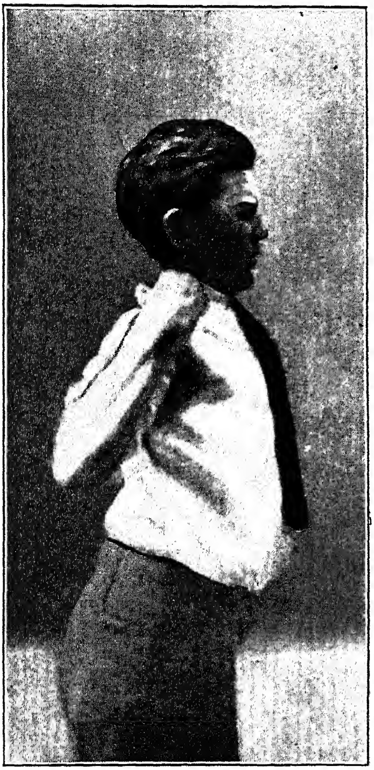


FIG. 50. — Terminal position of the shoulder blade exercise. Correct attitude.

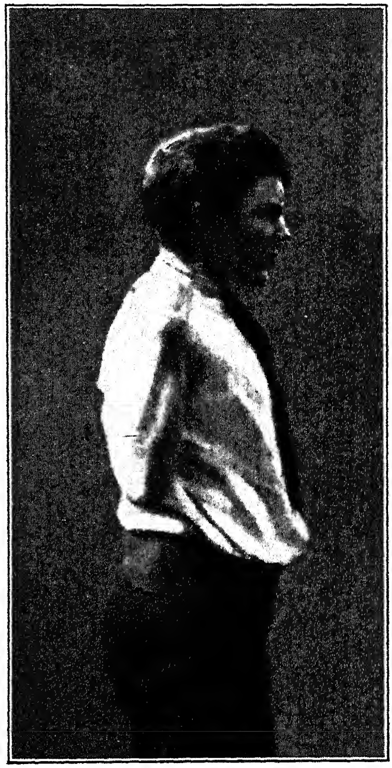


FIG. 51. — Incorrect terminal position for shoulder blade exercise.

A weak child could do this exercise three or four times in succession without resting, and may soon work up to ten times in succession, though one should always remember to relax the good standing position for a moment when it seems particularly difficult to hold, or is seen to be wavering.

The use of braces for round shoulders is only justifiable in extreme cases — mostly, if not wholly, of the resistant type — and after other measures have failed. In this phase of development, as in all others where the fault is one of weak muscles, the main remedy must lie in strengthening these and in removing all hygienic causes or persistent conditions that aggravate the trouble. In the chapter on the shoulders was explained the difference between resistant forward shoulders, in which some

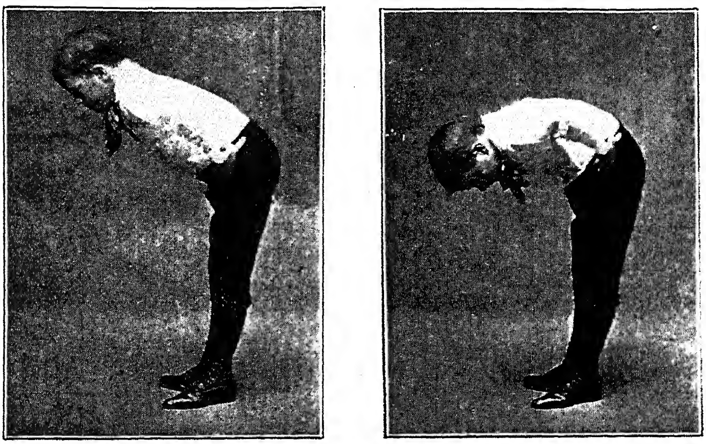
FIGS. 52–53. — Head exercise for correcting a forward droop of the neck. (*These, and succeeding illustrations in this chapter from Bancroft's "School Gymnastics, Free Hand," by courtesy of Messrs. D. C. Heath & Co.*)

structural peculiarity prevents correction in the usual ways, and round shoulders that may be corrected by exercise and hygiene. Resistant cases are apparently very rare.

2. **FOR CORRECTING THE POSITION OF THE HEAD.** — In many exercises the head and neck are treated as one, for many movements that affect one, affect the other. The fault most frequently found with the carriage of both is the forward slope of the neck — a drooping forward that is accompanied inevitably by a protrusion of the head and often by a thrusting forward of the chin. The remedy lies in strengthening muscles

on the back of the neck and shoulders that hold the cervical region of the spine erect. These muscles may, in the following exercise, be made to work strongly against the resistance of other muscles on the front and sides of the neck, which, in turn, lift the chest.

Still holding the correct standing position as a foundation, and placing the hands on the hips, with thumbs backward and



Correct — Incorrect

FIGS. 54–55. — Exercise for the position of the back.

elbows pointing straight to the sides, relax the head and drop it backward. This is the preliminary movement and is one of relaxation, having no effort in it. From this position lift the head upward and draw the chin strongly inward, as though making a double chin (Figs. 52–53). The effect is to straighten the forward slope of the neck, as with a checkrein, so that its column is upright instead of inclining forward. Relax the muscles again, letting the head drop backward, and repeat the strong upward pull. This exercise, like its predecessor, should be repeated from four to ten times in succession.

3. **FOR CORRECTING THE POSITION OF THE SPINE.** — Of the many exercises that affect the spine in various ways, the following is one of the simplest to be understood, and very effective for correcting exaggerated antero-posterior curves, and for strengthening the erector muscles on the back.

Placing the hands on the hips as described for the previous exercise, and holding the head firmly in a good position, bend the trunk forward from the hips, — not from the waist (Figs. 54–55). The bend should be only so far as may be done without throwing the head out of position, or bowing over the back. This will be rather slight with most subjects, especially at first, and it should be understood that the benefit of the exercise is not dependent altogether on the degree of the bend, but on its effect on the curves of the spine. It corrects an exaggerated lumbar curve, and the upper back muscles are strengthened through resistance to the pull of gravitation as the trunk bends forward. From this forward position rise to the erect attitude once more, and repeat the bending forward.

FIG. 56. — Starting position for arm movement to be combined with trunk exercise. Correct position.

When this exercise can be repeated ten times in succession without relaxing the position of the head or upper back, the work

of these upper muscles may be increased by adding an arm exercise. For this, instead of placing the hands on the hips, place the arms in the position shown in Fig. 56. While holding them there, bend the trunk forward as before, with the chin drawn inward. Without the support of the hands on the hips, the tendency to bow the back over will be quite strong, but the perfect alignment of the trunk should be maintained while the arms are stretched sidewise, with the palms downward, and then again bent to the position of Fig. 56. This arm movement may be repeated four times without lifting the trunk, which should then be brought to the upright position, with the arms hanging at the sides. After a moment's rest, repeat the whole exercise.

FIG. 57.—Incorrect position for starting the arm movement which is combined with the trunk exercise.

Eventually this exercise should be done from four to ten times in succession, the forward bend being held each time long enough to stretch the arms sidewise four times.

4. **FOR THE LOWER BACK AND WAIST (ABDOMINAL) MUSCLES.** — A sidewise bending of the trunk is good not only for certain muscles connected with the lumbar region of the spine, but has so stimulating an effect upon the circulation of the liver and other abdominal organs that it is one of the standard movements for improving digestion, and may well be in-

cluded for its dual value. The hands should be placed on the hips, the head and upper part of the trunk should be held firmly in correct relation to each other, and the trunk then bent directly sidewise at the waist line (Fig. 58). There should be no twisting of the shoulders, and the feet should be kept firmly on the floor. Return to the upright position. Bend the trunk in this way as far as possible, from four to ten times to each side, pausing for an instant each time in the upright position as a distinct finish to the movement and to make sure that the posture is correct.

FIG. 58. — Trunk bending to the side.

5. **FOR THE ABDOMINAL MUSCLES.** — Sit on a stool, or sidewise on a chair, in front of some piece of furniture under which the toes may be firmly caught to act as a brace and give a purchase. With the trunk and head perfectly erect, and the hands on the hips, drop the trunk backward from the hips to a slanting position (see Fig. 90). The degree of the bend will depend upon the strength of the abdominal muscles which keep the body from falling backward during the exercise, and which also pull it up into the erect position at the close. The last movement forms the second and most important part of the exercise. A trembling of the trunk, or a need for great effort in returning to the erect position, indicate that the backward movement has been too far. People with very strong abdominal muscles can drop backward until the trunk is horizontal; but

when that can be done, the exercise may better be taken sitting on the floor, still with the toes caught under some firm support, and the hands on the hips. From this position, sink slowly backward to a recumbent attitude — that is, lying flat on the back; from this raise the trunk again to a sitting position. At first, in rising from the recumbent position, there may be some slight help from the elbows placed against the floor, but this should soon be done away with, so that the work will be entirely by the abdominal muscles.

Whether this exercise be taken sitting on a chair or on the floor, *a firm alignment of the head and spine should be maintained throughout. A forward yielding of the head, or caving in of the chest, makes the exercise one of the worst aggravations of poor posture imaginable, while correctly done it is one of the best of correctives* (see Figs. 90 and 91). The backward movement should be entirely from the hip joint, and never from the lumbar region of the spine (hollow of the back).

This backward bending exercise should never be taken from a standing position, as it then becomes one of the most harmful movements for posture, as may be seen in the atrocious attitude of the first figure in illustration No. 11. Correctly taken, this movement is one of the exercises that combines strong physiological with postural effects, its influence upon the circulation and functioning of the abdominal organs being of the best. Repeat from two to ten times.

6. **FOR BALANCE OF THE WHOLE BODY.** — A deep bending of the knees, with the body sustained on the toes, is one of the best of balance exercises. Like all exercises of this class, if correctly done, it equalizes the tension of the muscles on the front and back of the body, establishing a just coördination between them, so that they are more apt to hold the body

in perfect equilibrium at other times. Of course this effect is lost if there be any yielding from the perfectly upright positions of the trunk throughout the performance of the exercise.

With the hands placed on the hips, rise on the toes, and, keeping the heels from the floor, bend the knees to an acute angle, or as far down as may be without tipping the trunk forward (Fig. 59). From this, rise to the erect position, not returning the heels to the floor until the knees have been stretched to their utmost. Repeat the exercise from four to twenty times.

FIG. 59.—Knee bending for balance.

The effect of this exercise on the circulation is fully as great as its influence on posture, and it is classed as one of the best of hygienic exercises.

7. **BREATHING EXERCISE.**—No table of exercises may be called complete that does not contain breathing exercises, both for their postural and physiological effects. While forced respiration does not of itself do all that is necessary to insure correct development or posture of the chest, it does much to restore a collapsed chest to a more nearly normal position, and to rouse the respiratory muscles to freer and fuller action during normal respiration. The stimulus of cold, fresh air, directly from out of doors, is most desirable for all exercises, and especially for respiratory exercises. Stand before an open window, with the hands on the hips to relieve the chest of any weight from the arms, and draw in slowly as full and deep a breath as possible; slowly exhale; repeat from four to ten times. Should

there be any dizziness, pause for a few normal breaths between the forced respirations. This breathing should be entirely through the nostrils.

This forced breathing may well be taken after every other exercise in the preceding list.

Summary. — This table of exercises may be tabulated for convenience as follows: —

1. Elbows forward and backward.
2. Head bending backward.
3. Trunk bending forward. Later, add to this, arm stretching sidewise.
4. Trunk bending sidewise.
5. Sitting, trunk dropping backward.
6. Knee bending.
7. Breathing exercise.

It hardly need be pointed out that this table contains pretty thorough all-over exercise, effective for both postural and physiological purposes. It is excellent for adults as well as for children. Because of the general invigoration resulting, it will do much good in cases of lateral curvature of the spine if none of the prohibiting conditions be present that are mentioned in the chapter on that subject. It is not, however, especially adapted to scoliosis, and is far from being an adequate series for the treatment of that condition. It may be well again to say that all such cases should have the care of a specialist.

FOR FAULTY FOOT POSITIONS. — The need for a specialist's care applies also to faulty foot positions, but for cases where a tendency to too much toeing out or toeing in has not yet developed into structural difficulty with the arch of the foot, there may profitably be added to the foregoing table one or two foot exercises. For too much toeing out, (1) sit, and turn the

foot (toes) inward against resistance of some fixed object, or the hand of some one assisting. (2) Stand, turn the toes inward, and rise on them repeatedly. (3) Walk across the floor several times on the toes while they are turned inward. For toeing in, these same exercises may be taken with the toes turned outward. In either case, especial care should be taken in all normal activities to sit and walk with the toes directed straight forward.[1]

Some orthopedists allow a very slight turning out of the toes to be normal in adults,[2] though the weight of modern opinion is in favor of the straight foot position. That the straight foot is natural for children may be observed by any one who will notice the feet of a class of children not conscious of being observed for this point. Their toeing out when they know the feet to be under inspection shows at once that it is a position artificial and cultivated. The best direction to give children for a simple standing position is "Feet together," and not "Heels together." Nature will take care of the rest, except in cases of weak arches and muscles that need special care. Later, a turning out of the toes may be a necessary part of the technique in certain gymnastic positions, as in the knee bending described for home exercise, and in some dancing. The position is found, however, to be less necessary in dancing of other than the advanced classic type than was formerly supposed.[3] Running, dancing, and rope jumping are among the best exercises to strengthen the feet if not kept up for periods of fatiguing length.

FOR CULTIVATING CORRECT CHEST PROPORTIONS. — The broad, correctly proportioned chest, may best be cultivated by those exercises, whether as formal gymnastics or in the form of sport, that extend the upper arm vigorously outward or upward from the shoulder joint. The tendency of the arm move-

[1] McKenzie, 98; Taylor, 132. [2] Ochsner, 106; Rotch, 118. [3] Taylor, 132.

ments in exercises 1 and 3 is in this direction, and large swinging movements with Indian clubs, *in which the arms are stretched sidewise to their full extent*, are even more vigorously calculated to cultivate breadth of chest. Swimming, rowing, and tennis are particularly adapted to aid such development, as the forward throwing movement of the arm, which is not good for posture either of chest or shoulders, is made with less force in these sports than in games where the ball is thrown from the hand. If tennis be played ambidextrously, the symmetry of its training is, of course, enhanced. Dr. Woods-Hutchinson favors also for such development of the chest the climbing and swinging exercises of the gymnasium in which the weight of the body is suspended from the upward stretched arms, as in overhead ladder, ring, bar, and stall-bar work. A clear distinction should be made between the effects of these exercises and of those in which the weight is pushed up from below, as on parallel bars. The sort of "traveling" (on ladders, etc.) that stretches the arms sidewise as well as upward, is especially broadening in its effect on the chest.

Even if the chest index show a normal development, there can be no doubt of the wisdom of having throughout the growing years a considerable amount of these wide, swinging, and stretching movements of the arms, whether in formal gymnastics at home or school, or in heavier gymnasium practice or sport. And always it should be appreciated that vigorous functioning of the heart and lungs, induced by active exercise of the leg and trunk muscles, especially when these lead to "breathlessness," has a profound effect on the right development of those organs and of the bony cage which contains them.

FOR THE GENERAL CONSTITUTION. — Finally, general vigor and tone of the system are reflected in posture, and for

this reason, especially, exercise should by no means be confined to the specialized corrective type. The constitution should be reënforced with vigorous out-of-door activities in which there is no thought whatever of posture. The life of every boy and girl should contain an abundance of those sports and games for which, when the motor system develops normally, there is an instinctive liking just at the time when heart and lungs, and all the great metabolic processes, are needing vigorous stimuli. Swimming, rowing, skating, tramping, climbing, baseball, tennis, indeed, all active games, — especially the team ball games, — athletic sports, horseback riding (cross saddle for girls), dancing (if not accompanied by late hours and other unhygienic conditions that nullify its benefits), — some of these activities belong to any comprehensive and adequate scheme of physical training, because of their effects on the general constitution as well as for their other educational values. None of them, however, can take the place of definite, corrective, formal gymnastics for the training of posture. Only such a type of work can overcome faults of posture and train erect carriage. The effect on posture of most other types of exercise is indirect, and one might be a devotee of any or all of these activities and still have very poor carriage of the body. This fact is illustrated at almost every athletic meet or tournament. The direct service of these varied types of recreative exercise lies in a different direction from, though one equally necessary with, the correction of posture; and just as these activities supplement and complement corrective exercise in the upbuilding of the body, so in turn must they be reënforced with selected gymnastic work of the corrective type for harmonious development of physique.

Plate XVI. — Piano Practice with the Feet properly Supported.

CHAPTER XV

HOME HYGIENE FOR POSTURE: LEARNING TO STAND AND WALK; NUTRITION; SLEEP AND SLEEPING POSITIONS; CHAIRS AND TABLES; WEIGHT CARRYING; MUSIC PRACTICE

ANY one charged with the physical development of large numbers of children, or even of one child, must realize the molding influence of those constant conditions that we call hygiene. Again and again weak phases in physique, like weak phases in mental work, are traceable directly to loss of power due to poor nutrition, late hours, overdoing with duties in the home or outside of it, or any one of numerous other influences that only those who control home conditions may remedy. In trying to correct posture, there is added to this list of adverse influences many that bear even more directly on the correct development and carriage of the body. For example, what chance is there of making permanent gain in the correction of posture, when the clothing worn by a child is so shaped that it continually pulls the figure out of true? The shape and size of chairs at home have as much effect upon the posture as they have in the much-discussed realm of school furniture. All of the physical conditions for home study and reading, piano or violin practice, even sleeping postures, are among the constant influences that are molding the body for good or ill during these susceptible years of growth.

LEARNING TO STAND AND WALK. — Whether a child's first efforts to assume the erect position in standing and walking be prompted by instinct or conscious effort, has been a

subject of considerable discussion among psychologists. As in most such discussions, the probabilities seem to be that both elements are so blended it is difficult to separate them. Whatever the impelling power may be, a normal child learns these things through such repeated efforts and failures, and such a long apprenticeship, that it is no wonder so weak a power shows lack of fixed control throughout the years of growth.

The head is the first part of his body which the child, unaided, holds erect; this power he acquires sometime between the second and fourth months; sitting independently is an accomplishment that comes from the seventh to the tenth month; the proud moment of standing alone comes about the eleventh or twelfth month, and is followed by walking somewhere between the twelfth and fifteenth months. Some infants omit the intermediate stage of creeping, and some, probably discouraged by the fright or hurt of an unusually severe fall, may revert for a period to creeping after learning to walk.[1]

In their efforts at standing and walking, most children, especially if very heavy in weight, need moderate restraint rather than encouragement. Long periods of standing or walking should be avoided. This caution applies to children well up to eleven or twelve years of age, though a robust child of ten should, if habituated to it through shorter walks, be able to walk two or three miles.

These precautions are to avoid overstrain and fatigue on all the muscles and ligaments that maintain erect posture, from the feet to the head. The ill effects of excessive standing or walking extend even to the bones, which are very pliable at this age, owing to the small proportion of mineral matter in their composition.

[1] Holt, 66; Rotch, 118; Cotton, 24; Trettien, 138.

The way in which an infant is carried may also have a permanent effect upon its posture and the correct development of chest and spine. Orthopedic surgeons consider that lateral curvature of the spine may be caused by the habitual carrying of a child over one arm. There is a great difference between allowing a child to sit in the crotch of the arm and letting it hang, face downward, over the arm. The latter position tends to crush in the chest on one side, and twist or rotate the pelvis and spine sidewise.

NUTRITION. — It is a mistake to think that all underfed or poorly nourished children come from homes of poverty. One often finds, on the contrary, that of the large numbers of children who rush to school in the morning with only a cup of stimulating coffee or tea, or whose midday meal is made up mainly of unwholesome pastries, the greater number come from homes of economic comfort or even affluence. The question of dietary *per se* is not germane to the present study; yet one can but point out that good nutrition is fundamental to the growth, and to the nervous and muscular power that are at the base of proper development and posture. In the chapter on school hygiene one instance is related where a marked gain in posture for a whole class followed so simple a matter as the drinking of a cup of milk in the middle of the forenoon — a gain from marked defects that seemed impossible of correction under previous conditions. When one adds to this physical gain an improvement in mental condition that increased by one or two hours the power of close attention, one appreciates somewhat the immediate influence of nourishing food. An underfed child, or one suffering in any way from poor nutrition, cannot be expected to stand erect, or to develop a good chest or other proper proportions or carriage of body.

SLEEP AND SLEEPING POSITIONS. — The large numbers of children who are up late on city streets help to explain the large percentage of so-called "backward children" in the schools. Nothing more quickly reduces nerve force or the efficient working of the entire organism than loss of sleep, — a fact to which many an adult afflicted with insomnia can testify. The revival of the curfew bell in many village and even city communities is a wholesome regulation physically as well as morally; and where parents have not enough control to regulate the retiring hours observed by their children, such help from community authorities might well be extended. Many children who retire at proper hours are found to suffer from sleeplessness, much of it apparently related to the number of hours of work done through the day, and also to the proportionate amount of this done in the afternoon and evening, — matters that bear directly on home study. The normal hours for sleep at different ages have been given as twelve hours at seven years of age, eleven and a half or twelve hours at ten years, eleven hours at fourteen, and eight and a half to nine hours from eighteen to twenty years of age.[1]

Like nutrition, sleep is fundamental to proper growth and development; but both nutrition and sleep have a constitutional, and not a specialized, relation to posture. The positions habitually assumed in sleep, however, have a very direct and important bearing on postural development. Sleeping positions have come to be recognized as a feature in scoliosis, an habitual lying on one side allowing a sag in the spine, between the hip and shoulder, which form the points of support. Reversing the position helps to correct such a curve, by reversing the direction of the sag, as shown in Fig. 60. Dr. Fitz is quoted as follows: —

[1] Hall, 55.

"The period of sleep is one half to one third the growing time of the child, and, consequently, the pressures and strain of an habitual sleeping posture have an opportunity to influence the growth of the vertebræ and ligaments and shape them in accordance with their relative positions at such times."[1]

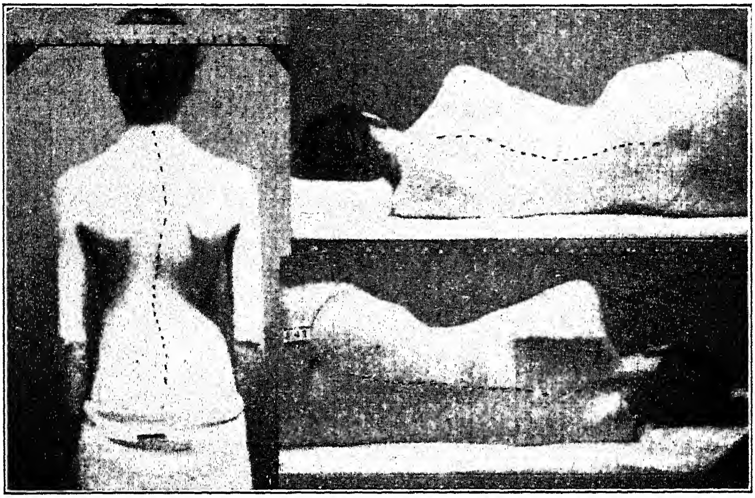


FIG. 60. — An S-shaped lateral curve of the spine and the effect of sleeping positions upon it. (*Courtesy of Dr. Fitz.*)

If this be true of lateral curves, it applies equally to the antero-posterior curves of the spine. Lying on the back on a very high pillow must obviously thrust the neck forward, while lying on the side with or without a pillow would increase any tendency to the forward position of the shoulder blades.

This does not mean that one should not lie on the back or on the side, or never use a pillow. It means that just as the habitual sleeping posture of a case of lateral curvature must be studied to ascertain a possible contributing cause, so must each case of postural defects of other types be observed for the particular habit that may be increasing or even causing the difficulty.

[1] Fitz, 39.

All authorities agree that for children of all ages the sleeping position should be changed frequently. There can be little doubt that there is a great tendency to use pillows that are too high, and that many people of noticeably fine carriage sleep much on the back and even without any pillow. Marie de Manaciene found that, among boys and girls, about forty per cent of the sleeping time was spent upon the back naturally, and also noted an instinctive tendency to lie prone on the face or stomach. The latter position she recommends for both children and adults for a half hour before rising, because of the influence in relieving pressures on the circulation.[1]

All of this only confirms the general principle that for the correct development of posture, sleeping positions, like those for standing and sitting, should be much varied, that the conditions (in this case, high pillows) should be right, and that individual faults of posture should be studied, that those habitual sleeping positions which aggravate or cultivate them may be avoided.

CHAIRS AND TABLES. — One has only to watch in the street cars the posture of little children sitting on seats so high that their feet cannot reach the floor, to realize how the custom of expecting children to adapt themselves to the chairs of grown-ups, both at home and outside it, must affect the posture of all but the most robust. The whole body seems to yield with collapsed chest and shoulders in the direction of the suspended feet, and there are probably few adults who have not a vivid memory of aching backs that, in their childhood days, accompanied dangling legs in church, parlor, or at the dining table.

The harm wrought by misfit furniture on the posture of school children has long been recognized. Specialists in the medical

[1] Manaciene, 94; Osborne, 109.

Plate XVII. — Supper and Home Study in a Nursery where the Furniture is of proper Size.

profession and in education and invention have combined, and commissions have been appointed, to devise furniture correct in shape and adjustable to the varying heights of growing bodies. Yet how much attention does this subject have in the average home? Probably the children are exceptional who, after they outgrow the "high chair" of infancy, are not expected to eat at a high table, seated on a chair that necessitates the craning of necks and the dangling of feet.

The harm of these positions is explained, with illustrations, in the chapter on school hygiene. In this place it may be stated that both for adults and children, the shape as well as the height of chairs is of especial importance for proper development and carriage of the body. Many chairs literally mold the sitter into most harmful positions. A forward vertical curve in the chair back will thrust the head forward if at the top, or make inevitable a sliding forward and downward in the seat if at the bottom. A lateral curve around the shoulders makes improbable a correct carriage of the shoulder blades for one who sits much in such a chair. The rounded shape thrusts the scapulæ forward, and if used habitually becomes a potent cause of round shoulders. A straight lateral line is unquestionably best for a chair back; also a backward slope that leaves the adjustment of curves to the sitter, while affording a plane surface against which to recline. In special chairs for use by students, typists, or pianists, it is possible to secure adjustable devices that place back supports at different heights for different sitters; but the ordinary house chair is probably best in the simple lines just described.

In Plate XVII is shown an ideal nursery, in which the little occupants have for their meals table and chairs that are changed in height for them as they grow. The little schoolgirl has the

same consideration in desk and chair for her home study, and note should be made of the low shelves for toys and books, which aid orderliness as well as posture.

Home furniture, easily adjusted as children grow, is as much needed as easily adjusted school furniture. While all homes may

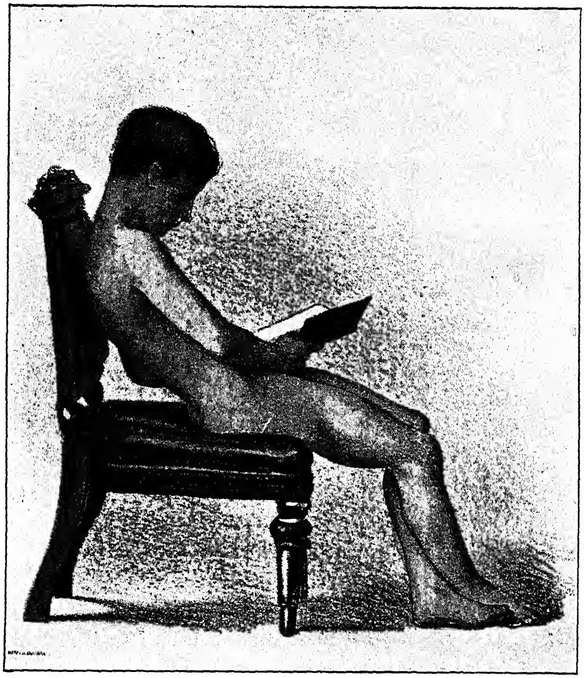


FIG. 61. — Poor conditions for home study or reading.

not afford special furniture for the children, it is possible for every home to contrive, if only with boxes, the proper support for the feet, and the right height of the chair seat in relation to the height of tables.

So long as five hours of school work are not considered enough in one day for growing children, and one or two hours more must be added at home, the conditions for home study should be as

free from injury as possible. These conditions include, aside from the height of furniture, some propping of books, so that the head need not be bowed over a level surface for reading and writing (Fig. 61). The dual effect of such a stooping position on eyesight and posture would seem too obvious to need discussion; but any one who tries to correct either defect in children finds, in a large majority of cases, serious neglect of the home conditions mentioned.

Photograph by Brown Bros.

FIG. 62.—The distortion of posture that comes from carrying little brothers and sisters.

WEIGHT CARRYING. — The carrying of heavy loads is fatal to good posture in a child. Indeed, even with adults, so ingrained do the effects of this become, that characteristic posture, permanently fixed in bones and muscles, is an accompaniment of many occupations. Witness for this the high shoulder of the postman who does not shift his load; a similar unevenness in the bookkeeper who stands or sits habitually with one side turned toward his desk; or the forward and sidewise yielding of the figure of the mother or nurse who carries in the arms much of the time a heavy child. It is this carrying of little

brothers and sisters (Fig. 62) that, of all the forms of burden bearing, oftenest distorts the posture of older children, though the ranks of child labor are full of pitiful examples of little shoulders overweighted (Fig. 63). If children could all be trained to carry weighty burdens on the head, whenever practicable, like the little ice bearer in Fig. 38, we would probably be a better and stronger race in many ways, with posture as excellent as his. It is not impossible that such a method of carrying school books, at least within the school buildings, may be found feasible, and if so, it would remove one of the most harmful features of school life.

Photograph by Brown Bros.

FIG. 63. — Stunted growth and poor posture result from the burdens of child labor.

The carrying of loads of books, and methods for relief, are discussed with the school hygiene of posture. It may well be pointed out in this place, however, that where children have such loads to carry, the plan of the school for reducing these should

be understood at home and all possible coöperation given from there. Sometimes such a school plan includes the taking home and returning of part of the load at noon and part at the close of the afternoon session, instead of all at one time. A bit of watchfulness at home would help in this. The plan suggested by a wise school principal of carrying the books on different sides different days; or — a suggestion of another principal — of dividing the load between the two arms, might well have home assistance for its enforcement. Where circumstances admit of duplicating the books, or at least the larger and heavier ones, so that one set may be kept permanently at home, the best solution of the question will undoubtedly have been found, until such time as all school work shall be done in school.

MUSIC PRACTICE. — Every pupil in piano and violin playing is taught most carefully the correct posture of wrist and fingers, but how many instructors ever say a word about the posture of the rest of the body? And yet this is a matter of fundamental importance to the musician as to others, considering its relation to general health. Not only would the fatigue of practice be lessened by such instruction, but permanent injury, telling on efficiency in all other activities, might be avoided by care for general habits of posture.

In Fig. 64 is shown the position induced by sitting at a piano without support for the feet — something required of almost every child whose piano instruction begins at an early age. The rounded back, collapsed chest, forward shoulders, and protruding head are as surely induced through sitting in this way at a piano, as at the dining table or in school or church. Plate XVI shows the feet supported by a little footstool, and the relief is apparent throughout the entire figure.

Violin practice is a fertile cause of lateral curvature of the

spine, and while the attitude that leads to it may not be wholly done away with in playing that instrument, every lesson or period of practice should be followed, or even interrupted, by exercises that bend the trunk and head in the opposite direction, or strengthen on both sides the muscles that are concerned in

FIG. 64. — Incorrect position at the piano without support for the feet.

symmetrical posture. The table of exercises already given is suitable for this, with especial emphasis on number four when bending to the right side, adding to the trunk movement a vertical stretching of the left arm, to be maintained during the bending.

Richter

Plate XVIII. — Queen Louise.

CHAPTER XVI

THE HYGIENE OF POSTURE: DRESS

When Louis XIV asked the opinion of his French tailor on a costume imported from England, the Frenchman looked him over with unconcealed contempt for the foreign rival, and said, "You are covered, sire, but you are not clothed."

Presumably dress is for the purpose of covering the body, but when art is added to utility, the strong points and beauties of the structure covered are emphasized, just as an architect adds strength to beauty in the design for a building by conforming to, and emphasizing, its structural features. The main difficulty with (so-called) civilized dress, from the hygienic standpoint, is that it is not content to take the human structure as it exists, but must mold it over into grotesque distortions. In this sense, most of us are usually "covered, but not clothed." So much is said of the effects of corsets and high heels for women, that the chief ills of clothing seem concentrated in these features, and the fact overlooked that the clothing of men and boys often has equally harmful features. Only one who is trying to correct the posture of boys in large numbers may, perhaps, fully appreciate how distorting are certain features of their clothing.

Most harmful, perhaps, is the making of coats so high in the neck behind that they lie like the yoke of a harness across the cervical spine, thrusting the head forward. With this position of the head is usually found the depressed chest and forward position of the shoulders. The shoulder position is still further

aggravated by shoulder seams in the coats, set so that they literally mold and hold the shoulder blades in a forward position. This means that practically the entire weight of the coat, instead of being balanced so that it helps to maintain a perfect equilibrium of the body when in the upright position, drags downward and forward. When to the weight of the suit coat is added that of an outer or over coat, it is not surprising that a slouching habit of carriage is characteristic of so many boys, even of those having strong muscular development.

This cut of coat is by no means exceptional. Ask a boy in such a suit to assume a perfectly erect posture, and the amount of push necessary against the collar behind will show in the upward lift of the coat in front, and a pouching out of the collar at the sides over the chest. Unbuttoning the coat is necessary to give room for the lifted chest, but so long as the neck and shoulders of the garment are cut wrong, the weight will drag the body forward and downward. A corrected position of the shoulder blades in such a coat shows in a wrinkle of the garment between the shoulders behind, indicating at once the exaggerated roundness which it both cultivates and is cut to cover.

These same faulty lines are found in shirts and shirt waists, where the shoulder seams are often badly misplaced and the collar band set so high behind that the linen collar rests upon it with the opening directed too much forward instead of upward. The neck in such a collar is held in a forward position as though in a vise, or as pilloried in the stocks of colonial days, and any training for correct posture in such clothing is helplessly wasted.

Another feature of boys' clothing that drags the figure out of place is suspenders. These have the same effect as the ill-cut coat. Nearly all suspenders seem to cut in at the hollow of

the shoulders in front, emphasizing the forward thrust of the tips of the shoulders, with the consequent protrusion of the scapulæ behind in wing shoulder blades, and dragging downward of the clavicle and ribs (chest) in front. A surprising number of small boys in the intermediate grades are found dragged downward with suspenders. In one school, situated in a "mixed" neighborhood as to economic conditions, in five classes from the fourth to the sixth year inclusive, out of two hundred and thirteen boys, one hundred and thirteen, or fifty-three per cent, were found wearing suspenders.

When to these faults of boys' clothing are added the stiffness and weight of paddings and interlinings, overweighting the front of the coat and designed to hide the very contortions of figure which they cultivate, it is not surprising that erect posture is one of the very uncertain features of growth.

All that has been said of the cut of garments for boys so that they hang as a harness yoke on the neck and shoulders, thrusting these forward and dragging the chest downward, applies as well to much of the clothing of girls. The lines of neck, collar, and shoulder seams in gowns are often as vise-like in their hold as when they occur in the heavier materials and stiff linen used for boys' clothing. For little boys and girls, underwaists and straps that suspend the weight of clothing from the shoulders, have usually quite the same effect as suspenders. Orthopedic surgeons find these to be among the contributing causes of lateral curvature of the spine,[1] and the physical trainer knows that they are among the basic causes of antero-posterior faults of posture.

As a remedy for all these misfit garments, a demand from the public for clothing that will fit the properly erect figure would

[1] Goldthwait, 54; Lovett, 86.

doubtless lead to different models from manufacturers, who are ever eager to meet a general demand.

In girls' clothing it is unnecessary to say that corsets and corset waists have an immediate influence on posture. The problem of corsets is by no means confined to the older girls of high school and college or to adults. In the elementary schools a large percentage of girls wear corsets in the last two years of the grades, — girls from thirteen to fifteen years of age. In some sections corsets are found to be worn even earlier. A new school of medical opinion has recently appeared in relation to corsets. Finding that for reasons of comfort, neatness, and elegance of effect in gowning, many women, especially those inclined at all to stoutness, will not give up corsets, Drs. Reynolds and Lovett of Boston and Dr. Dickinson of Brooklyn have made a study of the garment and its effects, with a view to determining the most and least harmful features, in order that they may "prescribe where they cannot proscribe." These studies include the effect of corsets in throwing the body out of good posture, effects caused by different shapes or cuts of the garment. The pressures exerted at different points by such shapes, and the harm produced by them, have also been investigated.[1]

The tightness of a corset, or the old fault of "lacing," is only one feature of its deleterious influence; its shape may work harm on a woman who never laces at all, and this may be as great from a soft "waist" as from a stiff corset. For corsets and waists, as for other ready-made clothing, the ~~public~~ gives too meekly-compliant a submission to tradition, and acceptance of whatever is commercially available, and an insufficient understanding of what constitutes beauty of figure. Young girls,

[1] Dickinson, 31; Reynolds and Lovett, 115; Mosher, 102; Galbraith, 44 below; Kellogg, 77, 79, 80.

especially, need to be set right as to what are the proper curves and outlines of the figure. Probably the girls are rare who do not think that a mature figure means one that slopes inward at the waist in front, and that to do away with this slope means to give up all tapering lines for the waist. A normal waist does curve inward at the sides in the space between the ribs and the top of the hips (pelvis or crest of the ilium — the bony structure that may be felt by pressing inward at the sides just below the waist line). This inward curve is apparent at the sides when looked at from the front, and continues all around the back, where the "hollow," if not exaggerated, forms one of the most beautiful lines of the figure; *but it does not continue* directly across the waist line or "pit of the stomach" in *front*. Pressure at that point in front is responsible for some of the worst displacement and crowding of organs, for much indigestion and malnutrition, and for some of the worst faults of posture. The appearance of an inward slope of the waist in front is caused by the maturing of the figure above the waist — the bust — and not by an actual inward slope of the waist itself. This fact every girl should understand clearly.

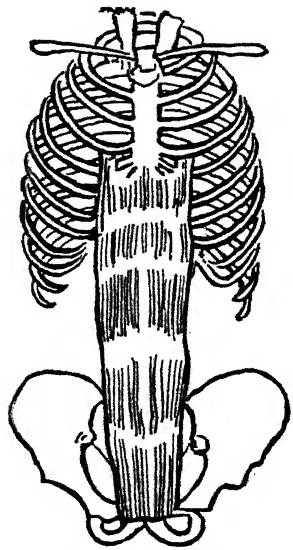


FIG. 65. — The rectus abdominus muscle which should determine the outline of the front of the body. (*Adapted from Meyer.*)

To appreciate these contours of the figure, one should remember that below the chest (ribs), the front of the trunk is made up entirely of soft muscles that yield easily to compression, having

no bony structure underneath to resist this. There is one long, straight muscle in particular that gives the outline to the front of the body and that is very important in posture. This is the rectus abdominus, attached above to the lower edge of the ribs and sternum, and below to the front of the pelvis, as shown in Fig. 65. When this muscle is compressed, it may be seen at once that the effect is to pull the chest down from above and tilt the front rim of the pelvis upward from below so that the natural hollow of the back is obliterated, and the upper part of the trunk bows over, as shown in Fig. 66. The stomach, intestines, and other organs are necessarily crowded out of place, and indigestion, constipation, headaches, backaches, and many ills that come from congestion and sluggish circulation are the inevitable consequence.

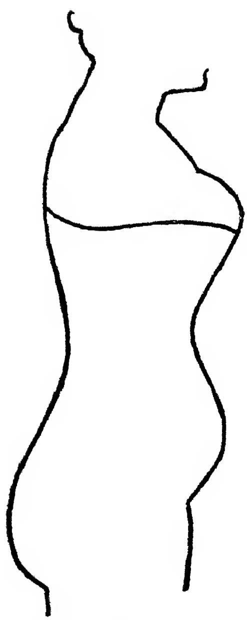


FIG. 66. — Figure distorted by compression at the front of the waist. (*Courtesy of Dr. Dickinson.*)

The so-called "straight front" corset has wrought a great improvement in this one particular fault of corset making, but most corsets are still cut so that they crowd the figure too much inward immediately on each side of the central line in front. For the width of the rectus abdominus muscle, and somewhat beyond it, the corset should be straight in front, curving outward above the waist to meet the bust; the inward taper should begin around toward the sides and extend from there entirely across the back. This inward curve of the waist in front is not the only harmful feature of ill-shaped corsets. There has arisen

an idea that because a straight line is good on the front of a corset it is equally desirable behind, and as a result the "straight-back" corset has come into existence. This is one of the most deforming corsets ever devised, and is responsible for a mode in posture that is ridiculous in the weak and fairly idiotic contours that it cultivates. By forcing the buttocks inward, this corset tilts downward the posterior rim of the pelvis, obliterates the lumbar curve, and forces a collapsed position of the chest, and a forward thrust of the head.

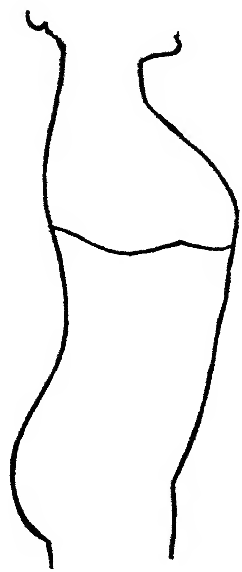


FIG. 67. — Correct lines for corsetted figure. (*Adapted from Dickinson.*)

The physicians quoted agree on the general points of corset shape, and also that the way in which a corset is laced and put on are as important as its cut. The greatest pressure should be below the line of the hips (*i.e.* below the crest of the ilium). At that point it may be very snug, as pressure there sends the organs upward and holds them in place, instead of dragging them downward. This pressure from below upward is a needed corrective in many cases for sagging stomach, intestines, and other viscera.

The authorities quoted also agree that the corset may fit the figure above the hip crests at the sides and back, hollowing in closely to the lumbar curve. It should not, however, exert such a pressure against the shoulders as to tilt the trunk forward beyond the perpendicular, for, even with the support of a corset, this throws a severe strain upon the overstretched muscles and ligaments of the back that keep the body from falling forward.[1]

[1] See Appendix, Note 8.

It should be clearly understood that sanction for the wearing of corsets applies to the adult, and not to the immature figure. One cannot make too emphatic the harm that results through crushed ribs, restricted growth, displacement of organs, and interference with all of the great physiological functions, from constriction during the period of growth. This emphasis becomes especially necessary in view of the fact that it is not uncommon to find girls in the elementary schools so bound by corsets that one could no more alter in them the curves of the spine, or the position of the chest, than a piece of wood could be bent. Drs. Williams and Fothergill attribute much of the chronic anæmia in young girls through the late teens to interference with the liver through tight dressing.[1]

Of these anæmic girls, Dr. Fothergill says, "They adopt corsets when they are still thin and undeveloped, and never *allow* the waist to develop." He recognizes that corsets transmit the pressure of skirt bands to the hips and ribs, which is a desirable thing, and protect from the pressure of such bands the organs in the region of the waist. As long as skirt bands are fastened around the waist, he believes that corsets should be worn, but they should be stiff, straight front, cut on the right lines, and large enough.

Only in an exceptional case of mature figure has any girl in the elementary schools an excuse for wearing corsets. The main reasons most women would give for wearing them are to keep the form (gown) neat as the figure grows heavier, and to avoid the discomfort of bands at the waist. The slender suppleness — or, if larger, the muscular firmness — of almost all girls of school age render useless a garment which at the best tends to limit proper development during the growing years,

[1] Williams, 144; Fothergill, 43.

and which at all times interferes with the free movements that alone can lead to the best condition of the muscles and organs of the trunk. The weight and constriction of skirt bands may be as harmful as, and far more uncomfortable than, corsets, and provision for union garments, or other means of suspending the weight of clothing should be used when corsets are not worn. An abdominal girdle which does not extend above the ribs, and from which the direction of pressure is upward from below the waist, is much worn by singers, who must have free action of ribs and diaphragm.

The dress of the feet has a great deal to do with the carriage or posture of the rest of the body, as well as of the feet themselves, and with ease and grace of movement in walking.[1]

When a very young child first bears his weight upon his feet, the foot muscles and ligaments are very lacking in strength, and have to gain this by use. By six years of age the adult type of foot is practically attained.[2]

The custom of making shoes for very little children on a straight model, so that there is no right nor left, is a great mistake, for the two feet are not shaped alike at this age any more than later, and the arch needs support especially at this time when it is first gaining strength to hold the weight.[3]

The shape of socks and stockings is quite as important as that of the shoes, the wearing of socks too short or inflexible having the same effect on the foot as a shoe of similar faults. The natural use of the foot in sandals or shoes that give play to the muscles is an especially important element in these early years. Unless he discloses through in-toeing or out-toeing some

[1] Taylor, 132, 133; Woods-Hutchinson, 72; Reynolds and Lovett, 115; Rotch, 118; Cook, 23; Holt, 66; Jaeger, 74; Pyle, 112; Galbraith, 44.

[2] Rotch, 118.

[3] Whitman, 143; Ochsner, 106; Rotch, 118.

weakness of the foot muscles and ligaments, a child will be found to use naturally the straight-foot position, with the toes pointing forward. The avoidance of too prolonged standing or walking at one time are also important. Dr. Rotch says: "Children should not be taught to turn the toes out . . ., as this puts the arch in a position where the muscles give it least support. The average dancing-school master is a fair example of what . . . respected traditions of the past can do to children's feet."

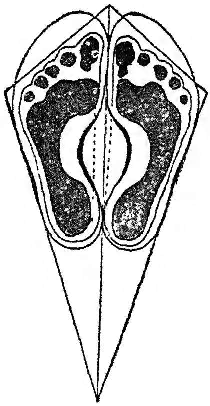


FIG. 68. — Normal outlines of adult feet (*Whitman*).

"Toeing out" may be a necessary part of the technique of some dancing and gymnastic positions, but this is proving to be much less necessary than was formerly thought, and some modern dancing teachers are modifying their requirements for toeing out.

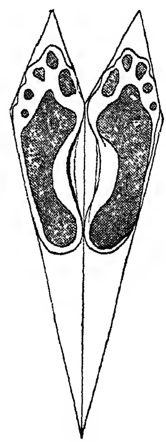


FIG. 69. — Abnormal shape of feet cultivated by narrow-toed shoes (*Whitman*).

Very high-heeled shoes, or those that through narrowness or pointed shape cramp the toes so that they cannot spread naturally when the weight is thrust upon them, make the foot more a hoof than a foot, so that it becomes a stiff, inflexible pedestal attached to the leg.

Figure 68 shows the normal outline of adult feet, and Fig. 69 the abnormal crook of the great toe that comes from wearing pointed-toed shoes. When such a deformity has been established, a pointed-toe shoe, if very long, may be comfortable, but it never gives the proper

play to the foot, as any one who has tried the comfort of so-called orthopedic shoes can testify. Above all, pointed toes and high heels should never be used for prolonged walking or standing. Weakened arches, bunions, and an abnormal strain on the ligaments that maintain the erect position are the inevitable result of high-heeled, pointed-toed shoes.

The greatest difficulty at present in extending the use of properly shaped shoes for women and older girls lies, undoubtedly, in their lack of æsthetic values. When such shoes can be made to appear dainty and beautiful, women will not hesitate to wear them. Meanwhile, many women of would-be common sense compromise by using orthopedic shoes for ordinary walking or long tramps, and shoes shaped differently for dress occasions. The author knows one woman of remarkable vigor for sixty years of age, known for the elegance of her dressing, who wears moccasins for long daily walks in the country.

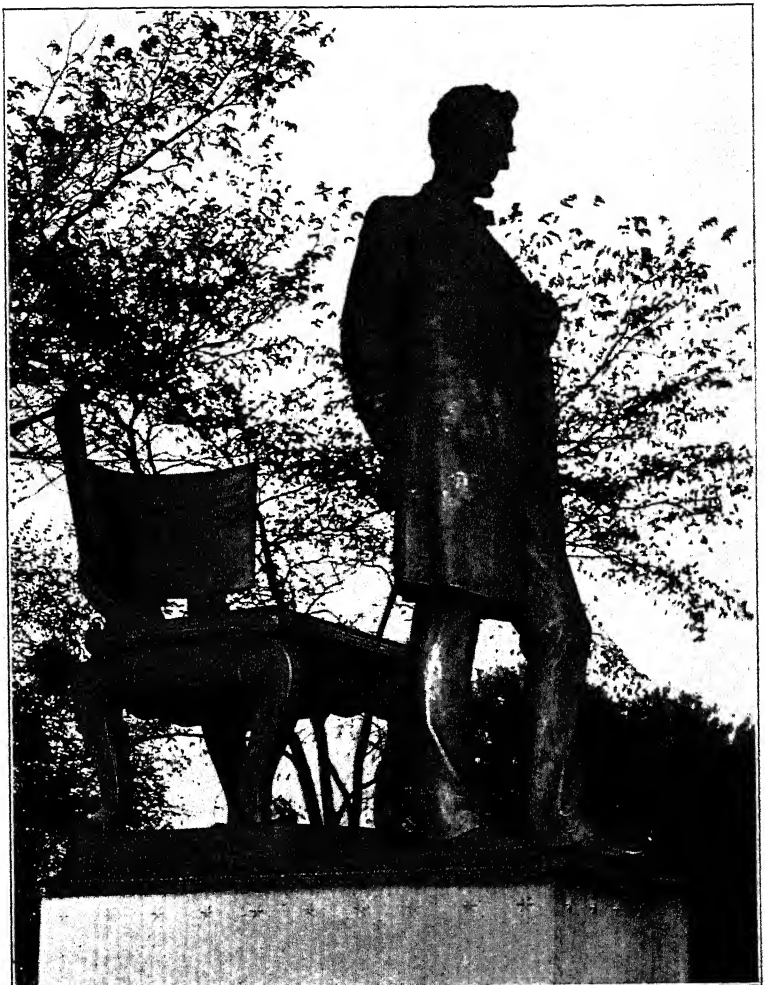
CHAPTER XVII

EFFICIENCY METHODS FOR SCHOOL TRAINING

THE efficiency methods here explained constitute a new and systematic way of getting and estimating results from the usual procedures for correcting the posture of school children. They possess a tremendous psychological power, shown in the interest, enthusiasm, and definite effort and zeal roused both among teachers and pupils, and have led to really remarkable results.

The essential principle of these efficiency methods is that this phase of physical development — erect posture — has been standardized so that each individual is judged, not merely for temporary ability to assume a good position, but for endurance in holding it. By means of this standardized test, the class teacher, who is not a trained specialist, may easily judge the posture of her own pupils, and also, through a percentage estimate, determine from month to month her success in developing her class as a whole.

By " standardized " is meant the adoption of definite criteria by which the subject may be judged. The term is adopted from the work of the new school of efficiency engineers, and experts in scientific management, who, in the field of industry, are quietly working a wonderful revolution by which waste is eliminated at a saving of millions of dollars annually, the output proportionately enlarged, time and labor saved for the workman, and his earning power increased. One of the fundamental principles of efficiency engineering is the standardiza-



Saint-Gaudens

PLATE XIX.—LINCOLN. CHICAGO.

tion of every element involved, from the actual physical labor of the workman to the cost of materials, — the adoption, in other words, of a unit of measurement whereby each step in the operation may be judged. In the realm of physical activity, this standardization has been applied to a wide range, from the coarsest movements of unskilled labor to the finest adjustments of hand and eye. The most famous illustration of the results of these methods is found in the improvement worked out in brick laying, whereby the brick facing on a great sky-scraper building in New York was done in days instead of the months that such a task usually takes. Another illustration is an increase in the output of cards containing typewritten data. A room full of girls, through a simple device for bringing the copy nearer to the work, increased their output from twelve hundred to three thousand cards per day.

This standardizing of industrial operations is done through a study of the movements of the worker, the quality and appropriateness of his materials and tools, and all conditions under which he works. Nothing is too small to escape notice, not even a movement that requires but a fraction of a second to perform. Nothing is more conspicuous in these efficiency methods than their humanitarian concern for the worker. One of the most important phases of the subject is the study of fatigue, the conditions that contribute to or lessen it, and the point at which it is reached. For instance, the girls in a factory were watched to see when they showed signs of nervousness and fatigue, with the result that they were given a ten minutes' recess at the end of every hour in which to get up and move around. Their working day was shortened by two hours, and yet, through the greater efficiency of methods, material, and conditions, there was a material increase in their wages, and in the output of the

shop. How long will it be before we look the facts of the schoolroom as squarely in the face and adapt methods to them instead of to tradition? The instance cited in another chapter of the physical and mental improvement wrought in a class of children by a daily cup of milk and fifteen minutes of quiet rest is eloquent of the waste through child, teacher, and school plant that might be saved by applying to school problems the methods of the efficiency engineer.

In physical activities the efficiency engineers have developed methods of motion study, and of proportioning hours of rest and work to the weight of loads carried and the resistance overcome, that are apparently achieving more immediate and practical results than years of laboratory work over the chemical products of fatigue and kindred abstruse problems, however important and necessary those may be. The results with over two hundred thousand children that have come from applying some of these principles to the development of posture is one indication of what may come from such work, and there are many other phases of education, both physical and mental, to which they will some day undoubtedly be applied.

The first element in the standardization of posture is the adoption of an effective criterion by which the teacher may know if pupils are standing correctly. This was found in the vertical line test, whereby the entire figure is judged by one glance of the eye, and details left for after-adjustment. The posture itself is that for which practically all physical trainers and orthopedists work, but the author became convinced that the traditional methods of securing it were not sufficiently effective, or they would lead to a better recognition of the subject on the part of class teachers. Such methods seemed, on critical scrutiny, to be too detailed and analytic, and really not so much

what the specialist uses, as an analysis or explanation of what he uses. The trained specialist knows at a glance whether or not a figure is erect; he does not build up that knowledge by looking separately at head, hips, shoulders, etc.

The vertical line test, then, is the first element in this standardization of posture, and the child is first judged by this means in a simple standing position. It is, however, a fact of common observation that a child who can assume a good position for a few minutes may not hold it; posture fluctuates. Some test of his endurance in holding the position was obviously necessary, so to judgment of his simple standing position was added two other means of judging his power for erect carriage, making in all a triple test. This is based on the question, What is a reasonable standard to expect the school to produce? Certainly its children should be able, not only to stand correctly, but to maintain this position in marching in and out of assemblies, or to the yard and back for recesses and dismissals. Marching was therefore added to the requirement, especially when it proved on closer study to be one of the surest means by which the body returns to its faulty habits of carriage, if the muscular tone and coördination for good posture be not well established. Such tone can only be cultivated through corrective exercise, taken with the body held in good position. Obviously it would be foolish to consider that a child had an acceptable standard of posture if he could not take his gymnastic exercise in a way that would insure his proper development. Therefore the maintenance of good posture during exercise was added, making altogether a triple test which has proved a thoroughly reasonable, and very effective, standard to which every child in a school, barring extreme pathological cases, should be able to conform.

This triple test for posture is, then, the standardization of the

subject for the individual. It is explained more fully in a succeeding chapter. Every child who passes this test is entitled to a passing mark on posture, even though he may sometimes fluctuate in his carriage; and those children who are habitually in good posture for standing or sitting should have more than a passing mark, being given the highest credit for the subject.

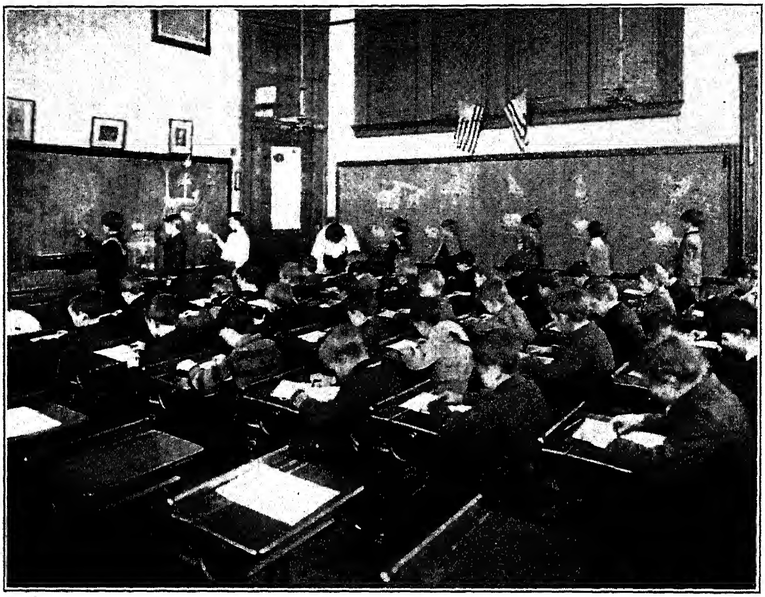


FIG. 70. — The molding influence of the elementary school.

The difference between marking children for posture according to this test, or by other methods, should be clearly appreciated. The two other methods most commonly used are (1) to give a general estimate based on a general observation, more or less expert; or (2) to give a numerical credit for different details, as five points for good carriage of the head, five for the shoulders, etc. The author is convinced that the general judgment of the posture of a class, even by the expert, is neither adequate nor

accurate. For example, after witnessing a demonstration of the triple test with a class of children, one keen observer — a physical training specialist — said of the group of children who had failed on the test, but who had been put in good position and were marching out of the room in it, "And you call those children poor in posture! Until a half hour ago I should have called them *excellent* in posture." Posture is one of the points on which children are marked for graduation from the New York City elementary schools, but until these efficiency methods were introduced, there were as many standards for posture as there were observers. The general judgment, therefore, even of the expert judging the class as a whole, is not as reliable as this test. One is an actual counting of facts — the scientific method; the other a general impression — the empirical method. The values of the two cannot be compared, for they belong to entirely different types of procedure. The author has always used statistical methods of estimating conditions and progress in school work, but has never found any method that was applicable to the results of teaching physcial training that were so exact a reflection of the facts as these efficiency methods.

The marking of posture by numerical credits for different details scarcely needs discussion after a reading of preceding chapters. The action and interaction of different parts of the body are such, and they are all so blended in every attitude, that even the scientists who have spent years of special study on the problem cannot satisfactorily classify the various combinations of these types of posture. How, then, may one give three credits for the head and four for the chest? Have the shoulders a greater valuation than the feet? One is in good posture, or he is not; he holds it habitually, or at least through a reasonable test, or he fails so to do. These are the essential facts, and the

value of details lies in the teacher's ability to recognize and correct them, and not in a numerical equation.

Before leaving the subject of credits it should be pointed out that one feature of great moment in these efficiency methods — a feature that, so far as the author knows, marks a new and very important departure in physical training — is that the pupil is credited for his physical condition or development, and not alone for the amount of time he devotes to the subject, nor even for his performance in a lesson. When this principle of credit for actual physical condition can be extended to other phases of development than posture, physical education will mean, by just that much more, something greater than the practice of exercises. Our schools and colleges should give their full or highest diploma only to pupils of sound physical condition; and throughout the school or college course this condition should be a distinct subject of credit, entirely apart from any means taken to achieve it, such as the hours devoted to gymnasium or athletic practice. These means, on the other hand, should have separate credit of their own, and the pupil who needs rest, or special diet, or any other means of physical upbuilding, should, if these things be prescribed for him by the physical director, be credited with them as much as with gymnasium practice or any other aids to condition or development.

This principle is applicable to both physical and mental development. When we can measure both the physical and mental powers in more definite and practicable ways, we may be able to distinguish between three separate and distinct lines of credit, viz. (1) the physical and mental powers or condition of the individual, (2) the mere number of hours he devotes to a subject, and (3) the amount of knowledge which he possesses.

The efficiency methods for posture proceed from the standardization for the individual, to the standardization for the class. To what extent is the teacher succeeding in her work in this subject? Heretofore she has had her own or an expert judgment as to whether it was good, bad, or indifferent. But there has been no definite point to reach — no means of knowing if she were gaining, or to what extent her efforts were telling in actual improvement in her pupils. One of the most important features in these efficiency methods has been the furnishing of a means of answering these questions. On the basis of the triple test, made once a month, the class is segregated into two groups for posture, one which passes the test and one which does not. The number in the good posture division, divided by the number present when the test is made, shows the actual percentage of pupils that passes a reasonable test on this subject. If only twenty per cent can pass the test, the teacher knows that she has some vigorous work to do on the posture of the group that fails. No teacher, no class, will rest content on a twenty per cent achievement. Right here lies the crux of the great psychological power inherent in these methods, a power that was a complete surprise to the author as they were worked out, and that proved to be a keynote in their success. The children will work for promotion from one posture division to the other, and also strive to raise their class average, with a zeal that they have never before shown in any phase of physical training except, perhaps, in the winning of trophies in athletics.

This interest and enthusiasm of the children show that these new methods have supplied a motive previously lacking in their work for posture. True, their pride and ambition have previously been appealed to, but the interest so roused has not hitherto been sustained. Prizes, banners, trophies, posture

pins, and honorable mention have each had their trial with similar results. These last-mentioned appeals are now classed with auxiliary aids; in pedagogical language they are incentives as distinguished from motives. The efficiency methods have supplied motivation to the pupils' work for posture.[1]

The quality of corrective teaching on the part of the teachers has similarly been imbued with new life and raised to a higher standard. Many a teacher has transferred her emphasis from the material of physical training (exercise) to the child. Instead of asking, "Is this exercise or dance step right?" "Will you give us a new game?" the specialist has been sought with the questions, "What is the matter with this boy?" "What can I do for this girl?" "Won't you just look at the improvement in this little fellow?" "This child has worked so hard and improved so much, do you think he might be promoted to Division I?" With such a point of view it is much easier for a teacher to see why her shoulder-blade exercises are not producing results, or how to improve the posture in some other exercise with correct execution of form instead of harming posture with incorrect execution. Best of all, back of this improved teaching is a spirit of personal sympathy and concern for the welfare of pupils that far transcends any pride or ambition for class ratings. The individual test leads to a recognition of the personal needs of each pupil as no other methods known to the author have done, and nothing in a long experience has shown so impressively the great spirit of devotion to the welfare of pupils that underlies the teaching profession.

Group teaching is another feature of these efficiency methods that has helped much in raising the standard of teaching gymnastics. Reward to the child through promotion from one pos-

[1] See Appendix, Note 9.

ture group to the other is another very effective element. This is a direct adaptation of the principle of frequent reward that is a feature of efficiency engineering. Another of these efficiency principles that is of primary importance is the keeping of systematic records. For the posture methods these records are simple — three figures a month for each teacher to write as a result of her triple test. There is no burden attached to them; and yet too much cannot be said of their influence and help for pupils, teachers, and supervisory officers.

The results of these efficiency methods may be stated in figures as follows: During the first term of extensive use of these methods they were tried in nearly one thousand classes of the seventh and eighth school years, including 32,967 children. In February of that term only forty per cent of these children could even stand correctly;[1] in June, eighty-three per cent of them could pass the triple test for endurance of posture in standing, marching, and gymnastic exercise. In the next school year the methods were extended to about five thousand classes and upward of 200,000 children from the second to the eighth school year inclusive, with commensurate results. There are but few children in those classes who cannot assume good posture, and the large majority can hold it through the triple test. The result is cumulative, and each term finds more children able to pass the test, and more who, through the establishment of correct habits and a gain in muscular strength, are rated "A" for habitually good posture.

[1] The preliminary working out of these methods in a few schools and classes was inspired by a marked decline from a formerly high standard of posture — a decline that had resulted from the introduction of numerous influences that proved to be detrimental to it.

In making up statistics of these results it has seemed best to confine them to the number of classes that could be personally examined by a small corps of eight specialists, in order that variation through the personal equation might be as slight as possible. The judgment of this group of workers was as nearly uniform as frequent work with a central authority could make it. They made all of the tests in the first term's work, and in succeeding terms examined personally the graduating classes in seventy-seven elementary schools, which included nearly four thousand children. During the first term, while the classes of the seventh and eighth years combined achieved an average of eighty-five per cent, the graduating (8B) classes reached only seventy-four per cent. During the second term in which these methods were used, the graduating classes rose to eighty-five per cent, and in the third term to ninety per cent. During the first summer vacation the posture efficiency dropped twenty-four per cent. That is, while eighty per cent of the children in a few classes and schools selected for this phase of the study could pass the triple test in June, only fifty-six per cent could pass the test in September, showing the effects of ten weeks without the special training. During the second summer vacation these same classes dropped only ten per cent as compared with twenty-four per cent the previous summer. That is, ninety per cent of these children passed the triple test in June, and eighty per cent in September. These facts show the cumulative effects of the work. A change from fluctuating to habitually good posture (ratings of B or C changed to A) is plainly apparent by actual count in schools doing the best work in the subject, and in those schools the good posture of the children is not lost even in the excitement of team games, in which their attention is thoroughly engrossed in the play.

An outline of the administrative plan by which these methods were generally introduced may be of service. For the first term the corps of specialists concentrated their attention wholly on this phase of physical training (posture tests and corrective exercise),[1] although without their aid the classes kept up folk dancing, games, and other recreative forms of work. Each class was tested by the specialist personally with the class teacher present, the latter then being given special help on the corrective phases of her gymnastic lesson.[2] Individual, class, and supervisor's or school records were started personally by the specialists, aided by many excellent suggestions from the school force. A very important feature of this campaign was a series of lectures on posture to the class teachers, illustrated by stereopticon pictures. Through these illustrations the eye was trained to discern the points of correct carriage. Many teachers attended these lectures voluntarily three times in succession, as they found the need for further discrimination or understanding of the subject. Many teachers' meetings were also held in individual schools, at which classes were put through the triple test and corrective exercises demonstrated.

In all of this work, children are never brought forward for individual criticism of posture in a way that makes them conspic-

[1] The latter was the regular course of study that has been used in these schools for many years. The exercises in this course are over ninety per cent corrective, although many of them possess dual and triple values, as explained in the chapter on Home Exercise, giving the work also a high percentage of hygienic and other values.

[2] Later, when the methods were extended to a larger field, one class was put through the triple test by the special supervisor, while a group of class teachers observed and then segregated each her own class in readiness for the inspection and possible correction of the specialist. This group work with the teachers was merely to enable a very small number of experts to cover a very large field, and not by any means because it was considered superior to the individual class help.

uous before the class. How to avoid this has been a special study, but that each child is one of a group has, in itself, almost eliminated all personal feeling. In criticizing posture in individuals, the positive, constructive tone has been adopted where it seemed necessary, especially when the methods were new. For example, the comment has often been, not, "This boy's shoulders are wrong," but, "This boy needs to work longer for strong shoulder-blade muscles." In a matter of this kind there can be no absolute rule, and individual tact must be ever in play. The difficulty of personal criticism proves, however, to be much less than might be anticipated, because of the group idea just cited, and also because the children come very quickly to regard the whole subject as they would any other in the school program in which their individual rating of good or poor is part of the day's work.

The efficiency of school training for physical development will never be what it should until much more than posture is standardized. Among the features that are greatly in need of such service are (1) other bodily functions or phases of development, (2) the amount of time needed for different types of exercise in order to produce their results, and (3) the amount of expert assistance needed by class teachers to produce results. The work with the efficiency methods here described has helped towards tandardization of (2) and (3), but has not completely solved the questions. It has been thoroughly demonstrated that for the cultivation of correct posture in children of elementary school age, and probably in those of higher grade as well, daily work with corrective exercises is absolutely necessary. The amount of time needed for this corrective exercise may vary with the introduction of new movements and the amount of individual help required by the pupils; but it should never be less

than fifteen minutes per day, though not necessarily in one period. For many children, especially those having pathological defects, special classes under the instruction of trained experts should be formed.

The amount of expert help in physical training is far from adequate in any public school system of which the writer knows. The function of such experts must probably always remain one of supervision and assistance, as the number required for teaching the children personally is usually prohibitive. The number of specialists that should be furnished to a school system should eventually be a matter of accurate estimate, based on definite knowledge of the number of classes in which may be obtained a fair average of results in the various lines of development. At present the number of specialists is determined by arbitrary conditions in which such a knowledge of the facts apparently plays no part. This condition is undoubtedly very largely due to physical trainers themselves. When they can demonstrate results in measurable terms, as is here done for posture, there will be an accurate basis for determining the number of specialists needed. Meanwhile, the multiplicity of physical activities grouped under the head of physical training, to say nothing of school hygiene, makes it plainly evident that every school of forty classes or over should have at least one expert to direct and assist with its gymnastics, folk dancing, games, athletics, and other types of exercise.

When the organization of an industrial plant on principles of efficiency, or scientific management, is first attempted, the management, it is stated, is almost invariably inclined to consider impossible the cost of the corps of experts required. Only experience convinces them that an expenditure in this way of ten or twelve thousand dollars or more per year will save a much

larger amount by checking waste of all kinds — waste in effort, material, etc. — and by increasing the output through greater efficiency. It is, perhaps, not too much to predict that when physical trainers can demonstrate with equal certainty the results of their work, the outlay for salaries that will command adequate service will not be begrudged.

Vandyke

PLATE XX. — PRINCE RUPRECHT.

CHAPTER XVIII

THE TRIPLE TEST AND GROUPING FOR POSTURE

WITH an understanding of the vertical line method of judging good posture, each teacher should once a month put her class through a triple test which indicates the endurance of the pupils in holding a good position.

On the basis of this test the class should be divided into two groups — Division I, composed of those who pass the test, and Division II, those who do not pass. Both divisions should take their gymnastic lesson at the same time, but stand in two distinct groups, which enables the teacher to concentrate attention on the division most needing help for corrective effects from the exercises. This grouping also incites the pupils in Division II to work for promotion to Division I.

The triple test consists in judging each child's posture in (1) standing, (2) prolonged marching (four or five minutes), and (3) selected exercises. A child may be able to assume good posture for a few moments, but lose it when he returns to habitual activities or when his attention is diverted to other things. For this reason, to judge of posture in the standing position alone is not adequate, and the triple test has been found eminently fair and satisfactory. No child who has habitually good posture could fail in this test, and any child who is equal to it certainly deserves a passing mark on the subject.

THE TRIPLE TEST is conducted as follows: —

(1) **STANDING TEST.** — Pupils should be looked over in profile. Those who do not stand in correct posture should be

eliminated, — that is, asked to sit down or to move to one side. In a classroom this review of the standing position may be made by having the entire class stand at once, or else row by row, the teacher looking them over from the side of the room; or, if she be in front, by having the pupils face to the side. Those

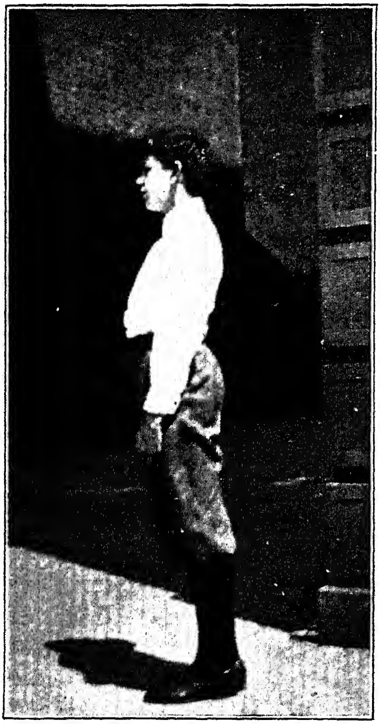


FIG. 71.—Poor posture.

FIG. 72.—The corrected position (leaning forward very slightly too much).

who stand poorly should be asked to sit; those who stand well should move forward and form a single file across the front of the room ready for the marching test. In judging, it is quicker and more systematic to dispose of one row or aisle at a time, as just described, than to designate pupils promiscuously.

In a gymnasium or on other free floor space, one may often get the best perspective for this standing test by ranging the pupils in single file around the outer edge of the room.

(2) **MARCHING TEST.** — The pupils selected for their good standing position should then be put through an endurance test in marching for four or five minutes. An effort should be made during the march to distract their attention from any artificial effort for posture by drilling on tactics, such as facings, marking time, halting, etc. It will be found that as the march proceeds, old muscle habits will reassert themselves, and many pupils who could hold a correct position for a few minutes of quiet standing will fall into habitually faulty attitudes as they march. Heads will droop, chest sink, and shoulder joints slip forward. As these faults occur, the pupils showing them should be dropped out of the line.

(3) **EXERCISE TEST.** — The pupils who pass the standing and marching tests should then be put through the third part of the triple test, which is designed to show the strength and co-ordination of those muscles that are weak in poor posture, particularly those that hold the spine erect. In certain exercises, especially those that put the arms in an upward position, the posterior muscles, if weak, allow the body to react with poor positions, the head drooping forward and the upper part of the trunk sinking backward; or, if the weakness be in the lumbar region, an overextension backward may occur, leading to the lordosis position (excessive hollow in the back).

One of the best exercises to test these points is a long sweep of the arms forward and upward, fully extended, returning them sideways and downward to position at the sides. Any of the home exercises noted in a previous chapter would also be good. Pupils reacting in these exercises with the faults of execution just mentioned should be dropped from the group.

This closes the triple test. Pupils who have maintained good posture throughout the test (that is, through standing, marching, and exercise) should be called Division I and thereafter should stand apart in one group for the gymnastic lesson. The remainder of the class should form Division II. These pupils should take their gymnastic lesson with Division I, but as they are a distinct group, the teacher may more readily concentrate her attention on helping them to correct their posture with the exercise. Indeed, this is a fundamental object of the testing and grouping, and the methods for improving the posture of Division II with exercise will be dwelt upon at length in a succeeding chapter.

The triple test should be given to each class entire once a month. A teacher fairly rapid in discriminating posture can test a class of forty or fifty pupils in the usual physical training period of fifteen or twenty minutes.

Posture fluctuates in the same individuals. Conditions of fatigue, worry, lack of sleep, poor nutrition, or illness of any kind may affect it. Some of the pupils, therefore, who pass the test for Division I may not always be found in good posture. The test therefore selects (1) those who have habitually good posture (rated A), and (2) those who are good most of the time, but who may fluctuate somewhat (rated B). Instances occur where pupils who have been in Division I for a considerable time will lapse into poor posture for long periods. Where such lapse continues for a number of days, the pupil may well be returned to Division II without waiting for the monthly test. In other words, it is not kind to a child to allow him to feel that he has achieved satisfactory posture when he has not. *Teachers should guard against rewarding even long effort and marked improvement by promotion to Division I, if the child have not actually arrived at*

good posture. Such promotion encourages a child to relax his efforts before arriving at the result desired.

Pupils who have lateral deviations of posture (scoliosis or other pathological defects), but who are able to maintain a good position through the triple test, may be allowed to stand with Division I, but should not be rated in posture (A or B), being marked instead "medical defect." These pupils should not be counted in estimating the percentage of good posture in a class.

The method by which the two groups take their places for the gymnastic lesson is susceptible of many variations, equally desirable, the essential requisites of any method being simplicity, a minimum of commands, and rapid and quiet changes that avoid collisions. Some teachers assign their pupils to permanent seats according to their divisions in posture, but so many other considerations usually enter into seating, that this may not always be practicable. The following methods for changing places for posture groups have been found to meet all of the requirements.

Pupils who have to pass to the opposite side of the room to join their groups do so before the other pupils stand. Assuming for illustration that Division I will occupy three aisles on one side of the room, the pupils seated along those three aisles who belong to the other division (II) are asked to stand, face the rear, and march by way of the rear of the room to take any vacant seats on the opposite side. At the same time the pupils who belong to Division I, but who sit on the opposite side of the room, must also change places. They stand, and pass forward to the front of the room to cross over to the vacant seats in Division I. The pupils in each division having thus filled the seats vacated by the pupils of the opposite division, the entire class is asked to stand, it being then grouped in two divisions.

The change of places is usually made to such commands as, "Pupils who change — Stand!" "Pass!" A third order is then given to the entire class, "Class — Stand!"

In this changing of places for groups or divisions, by having pupils for Division I pass to the front of the room and those for Division II to the rear, there are no collisions in the aisles. The method by which pupils return to their own seats is just the reverse, the commands being: "Pupils near their own seats — Sit!" "The others — Pass!" As before, pupils returning from Division I pass by way of the front of the room, and those from Division II by the rear. With very little drill these changes are made very quickly, the children usually running to their places. As Division I enlarges from month to month by promotions from Division II, there are fewer pupils to change, and the time required is lessened. In a large class where many pupils change, from seven to ten seconds is the usual time for this grouping, and the same time or less is consumed in returning to seats after the gymnastic lesson.

When the gymnastic lesson is taken in a gymnasium, the grouping may be accomplished as the pupils leave the classroom, those for Division I being asked to stand and pass first, and those for Division II to follow. They thus pass on to the floor in groups already selected. A formation that leaves each group extending in files from front to rear, as in the classroom, is found better than one that masses either division horizontally across the front or rear.

In both gymnasium and classroom, Division II should stand on the side next the windows, that the teacher may have the benefit of the light in observing posture.

PROMOTION FOR POSTURE. — One of the essential elements in the success of this group teaching for posture is

the zest with which pupils work for promotion from Division II to Division I. The test alone will not arouse this interest; the grouping must be a distinct, systematic part of each lesson. This cannot be too strongly stated. The interest of the pupils in promotion is one of the most marked features of these methods, and the teacher should rouse pride and ambition to this end. Many teachers have voluntarily stated that this element has relieved them of the necessity for continual "nagging" about posture, and substituted therefor a motive that makes the child eager to improve.

A very potent influence to this same end is class pride for the percentages explained in the succeeding chapter.

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CHAPTER XIX

CLASS STANDARDS; INDIVIDUAL AND CLASS RATINGS; RECORDS

THE triple test standardizes posture so that it is possible to rate a pupil on this subject. Every pupil who successfully passes the triple test for Division I may be considered as passing on this subject, and therefore entitled to at least a passing mark. As before stated, the posture of some of these pupils may fluctuate slightly at times, but will be good in the main. There will be others in Division I who have habitually good posture, no matter how they may be occupied. The class teacher is the only one who can judge of this habitual posture. These pupils should have the highest rating for the subject (A). Some teachers have preferred to have two sections in Division I, one for A and one for B pupils, and this is unquestionably an advantage. Each child should keep his individual rating on this subject, and the teacher should have the names of the class listed with the posture rating opposite each. In discussing ratings farther on in this chapter, an admirable form or posture bulletin is shown in which the pupils' names are classified in this way according to their ratings.

Habitual sitting positions are, of course, of much importance in any rating of pupils for posture. These should be considered in giving a pupil the rating of A. Any pupil who can pass the triple test for standing posture could pass any test for sitting, short of habitual positions. Therefore, it is the A rating that should include these.

Niehaus

PLATE XXI. — GARFIELD. CINCINNATI.

CLASS PERCENTAGES. — The triple test not only standardizes posture for the individual, but furnishes a basis for standardizing the class as a whole, and this forms a distinct and very important element in these efficiency methods. This class standardization is arrived at by figuring the percentage of pupils in Division I, dividing the number who pass the test by the total attendance — not register — at the time the test is made. For instance, with forty pupils present in a class, and but ten passing the triple test, the class percentage on posture is but twenty-five per cent. This does not mean that each pupil of those passing is rated at twenty-five per cent, but that twenty-five per cent of the pupils passed the test. It is the class record on the subject. Neither pupils, teacher, nor principal will rest content with so low a figure for this or any other subject, and unquestionably an enormous amount of the zeal and satisfaction which these efficiency methods have aroused, has come from this means of estimating class record and progress. It is a great satisfaction to a teacher to have a concrete means of estimating the results of her work, and there is a strong element of justice involved in such a method.

FIG. 73. — A teaching problem.

These percentage figures have roused an interest on the part of all concerned that has been most impressive. Many humor-

ous incidents have shown the interest of the children. The boys in one class waylaid a classmate after school and pommeled him because his poor posture kept the class from one hundred per cent. Another child announced at home with great delight that he had been "promoted to Division I in postrophy."

CLASS RECORD. — The class percentage should be figured each month when the triple test is made, and a systematic record kept in each class, both on the blackboard and in some permanent form in some record book. This book may well be devoted exclusively to the posture record, or part of some other permanent record book may be used. A separate book is preferable, as it gives room for the names of pupils with their individual ratings (A, B, or C) in addition to the class schedule. A class record for a first term's work might appear as follows: —

Date of Triple Test	Attendance	Number Passing Test	Percentage in Div. I
September 10	46	16	34
October 10	47	22	46
November 10	48	30	62
December 10	47	32	68
January 10	45	37	82

When placed on the blackboard, this record rouses the pride and interest of the class so that they work to raise the percentage from month to month. Another form is a bulletin on which appears, in addition to the monthly percentages, the names of pupils in Division I, who are classified as A or B. *The class should always know its percentage,* and whether it is gaining or losing, or marking time from month to month. *To omit this is to fail of using one of the most potent psychological elements in the*

Class Record in Posture for Term Beginning ———
Class 6 B

	Attendance	Number Passing Test	Percentage Good Posture
February 4	43	32	74
March 4	43	34	79
April 3	42	38	90
May			
June			

Pupils in Division I for Posture

A

Mary Greene
Isabel Clark
George Mack
Ellen Schneider
Grace King
Fanny Masters
Rose Ryan
Frank Gray
George Perkins
James Mehan
Giovani Luigi

B

George King
Frank Munger
Margaret Leopold
Ellen Leonard
Jefferson Davis
Helen Mix
Jenny Keagan
Sarah Lornegan
Ruth Steinheimer
Sarah Mills
Rebecca Schmitt
Theodore Rogers
Luke Regan
Sylvester Parker
Mary Alexander
Thomas Judkins
Roger Marks
Lester McCormick
Mary Thompson
Katherine Temple
Kate Gonzales
Elizabeth Fitzsimons
Ella Munson
George Kittridge
Hans Hansen
Jans Jacobson
Mary Peterson

situation, — the one that, coupled with personal desire for promotion from Division II to Division I, relieves the teacher of the necessity for continual nagging about posture, and substitutes therefor a motive in the child himself.

It is not at all unusual when these methods are first introduced to find classes that are naught on the first test, — that is, classes in which not a single child is able to pass the test. The teacher should never hesitate to put down these figures, nor should she ever strain a point to promote a child to Division I before he has actually achieved the posture that entitles him to be there. In other words, it is not figures, but the facts they represent, that are essential, and it is unjust to a child to lead him to think he has reached a passing mark on this subject when he still needs the extra effort and attention for posture that comes from being in Division II. Some teachers find it hard not to reward prolonged effort and marked improvement by promotion to Division I before the child has enough endurance in a correct position to go through the test. Other means for encouragement for such children may be found than allowing them to think they have arrived at the desired standard.

A systematic record of her class percentages may serve the further purpose of helping a teacher to find the faults in her own judgment or teaching on this subject. For instance, if the percentage be very high, a teacher should make sure that her standard is not too lenient. On the other hand, if the percentage shows scarcely any advances from month to month, the teacher may at once conclude that she is not doing what she should to develop the posture of the pupils in Division II, — that she is failing in some way to get the corrective values from her gymnastic lesson, or otherwise missing the points necessary for improvement.

PUBLIC SHOOL ------. SCHOOL RECORD OF MONTHLY TESTS IN POSTURE. TERM BEGINNING FEBRUARY, 19—

	8 B. B.			8 B. G.			8 A. B.			8 A. G.			7 B. B.			7 B. M.			7 B. G.			7 A. B.[1]			7 A. B.[1]		
	Attendance	No. Passing Test	Per Cent of Good Posture	Attendance	No. Passing Test	Per Cent of Good Posture	Attendance	No. Passing Test	Per Cent of Good Posture	Attendance	No. Passing Test	Per Cent of Good Posture	Attendance	No. Passing Test	Per Cent of Good Posture	Attendance	No. Passing Test	Per Cent of Good Posture	Attendance	No. Passing Test	Per Cent of Good Posture	Attendance	No. Passing Test	Per Cent of Good Posture	Attendance	No. Passing Test	Per Cent of Good Posture
February 8	43	36	84	39	33	85	38	26	68	39	32	80	31	17	55	37	27	72	36	32	88	41	30	73	39	30	77
March 13	40	37	93	39	33	85	39	34	87	40	30	75	32	20	63	37	29	78	34	24	70	39	34	87	38	29	76
April 16	40	37	93	38	34	89	41	36	89	36	30	84	30	22	70	35	30	85	33	24	73	33	29	87	39	34	87
May 16	39	33	84	38	33	87	41	38	92	33	26	79	29	21	73	27	24	88	33	27	82	32	28	87	34	27	80
June 20	40	37	90	37	33	89	41	39	95	41	34	83	30	23	77	34	31	91	35	27	77	36	29	80	35	30	86

	7 A. G.			7 A. G.			6 B. B.			6 B. M.			6 B. G.			6 A. B.			6 A. G.			5 B. B.			5 B. G.		
February 8	33	28	85	35	31	88	40	31	78	43	32	74	42	39	93	41	22	54	47	26	55	44	33	75	47	39	83
March 13	30	24	80	34	25	74	39	32	82	43	34	79	43	43	100	40	26	65	42	32	76	41	32	78	44	37	84
April 16	26	21	81	30	22	73	33	31	93	42	38	90	39	39	100	42	30	71	43	36	84	39	34	86	41	37	90
May 16	27	20	74	28	23	82	38	24	64	39	34	88	33	33	100	35	28	80	45	41	91	38	34	89	35	31	89
June 20	23	19	83	27	25	93	39	28	71	42	39	92	38	38	100	38	31	82	43	41	95	38	35	91	40	35	88

	5 A. B.			5 A. G.			5 A. E.			D			4 B. B.			4 B. M.			4 B. G.			4 A. B.			4 A. M.		
February 8	49	32	65	42	31	74	39	31	80	22	12	54	44	22	50	41	32	78	43	29	67	38	19	50	43	33	77
March 13	40	33	82	43	38	88	34	27	79	20	15	75	44	25	57	42	31	74	41	27	66	39	21	54	39	32	82
April 16	41	29	71	36	28	77	31	25	80	21	15	71	43	25	58	37	30	81	35	25	71	33	20	62	37	30	81
May 16	38	34	90	35	29	84	33	30	92	16	16	100	40	24	60	37	32	87	38	28	74	33	21	63	34	30	88
June 20	42	36	85	37	28	76	34	30	88	19	13	68	41	26	63	41	36	88	40	30	75	35	23	66	38	32	84

	4 A. G.			3 B. B.			3 B. M.			3 B. G.			3 A. B.			3 A. G.			2 B. B.			2 B. G.			2 A. B.		
February 8	43	23	53	30	30	77	40	35	85	39	34	87	40	28	70	33	24	72	43	23	51	41	36	87	40	21	53
March 13	40	26	60	39	29	71	30	24	80	39	35	90	40	30	75	37	27	72	44	27	61	41	37	90	40	26	65
April 16	39	25	61	34	25	74	35	30	85	35	32	91	38	29	76	32	24	75	44	29	66	42	34	81	35	27	77
May 16	43	28	65	38	27	71	35	32	91	34	31	91	35	29	83	33	28	84	41	29	71	38	33	86	38	32	84
June 20	42	30	71	36	32	90	38	35	92	31	36	95	36	28	78	33	29	88	43	33	77	37	31	83	40	38	95

[1] This is an actual record of tests made under very critical supervision. The seventh and eighth years were using the efficiency methods for a third term and grades below for a second term. The figure denotes the year or grade, as 8, the eighth year; the letter following it, the first (A) or second (B) half of the year; the second letter, boys, girls, or mixed class. "D" means finishing minimum requirements for "working papers"

SUPERVISOR'S RECORD. — A supervisor's record for the principal, as here given, is of very great value as showing the condition of the various classes in a school at any time, and serves also to indicate those teachers who may need help on this subject. In the accompanying record, note, for instance, the sudden gain in the last month in the 3 B Boys class; the lack of appreciable gain in the 5 A Girls class; and the splendid, sustained record in the 6 B Girls. The great differences made in percentages by fluctuating attendance is apparent in many cases, and for this reason the attendance on the day of the test and the number passing the test need to be considered in judging the percentage. It is wise to give teachers some leeway in the choice of days for making the test, that attendance may be good when it is done. For instance, it might be understood that the posture test should be made during the first week of each month, and the record sheet sent around for the filling in of the figures on the last school day of that week. The clerical work for such a supervisor's record is very slight, the sheet being sent through the classes once a month, that each teacher may fill in the three figures resulting from the month's test. The sheets in general use are of legal or foolscap size.

REASONABLE STANDARDS. — Just what is a reasonable class percentage on posture? Experience has shown that in one year's use of these efficiency methods eighty-five per cent is an average figure, the largest number of classes ranging from eighty to eighty-nine per cent, and a considerable number reaching one hundred per cent, and this, although it is not at all unusual for many classes to start at zero. The effect of the work is cumulative, and each term sees an advance on the ratings of the previous term, as the development of the children progresses from grade to grade. Were it not for pathological cases, from ninety-

five to one hundred per cent might well be expected of every class. In making this statement, the pathological cases are considered to include, besides orthopedic cases (lateral curvature of the spine or other defects of the bony structure), those pupils who are weak from recent illness, the anæmic and tubercular cases that properly belong in a fresh-air class, extreme cases of underfeeding or poor nutrition, and those occasional cases of deficient nervous power, heart weakness, etc., that place a child below normal physiologically. It should by no means be inferred from the foregoing that no such pathological cases will be found in Division I. On the contrary, very many children of all these types pass the triple test, and there seems to be no reason why, as a result of several terms' work (often less) with these efficiency methods, every child not so afflicted, and many who are, should not be able to pass the test for posture. An improvement in the general appearance of health in pupils has been noted by several principals, and improved posture on the street has also been a subject of voluntary comment.

PATHOLOGICAL CASES. — In testing a class, all pathological cases should be included, except the occasional extreme cases that are excused from all exercise on a physician's statement. Orthopedic cases, unless excused for reasons explained in Chapter VI, should be included in the test, but not counted in any of the records, either for attendance, or in the groups. As before stated, such children need, perhaps more than any others, every possible encouragement to hold themselves in good position; but even if they can do this long enough to pass the test, which is not unusual, they should not be rated, but marked "Medical defect." It may be well, however, to encourage such pupils by allowing them to sit or stand with Division I.

CHAPTER XX

HOW TO CORRECT POOR POSTURE IN THE CLASSROOM: TRAINING THE MUSCULAR SENSE

The triple test, and all else described in previous chapters, is merely preliminary to the teacher's real work for posture — the corrective teaching through which alone those pupils deficient in posture may receive the development they need. This development lies in two distinct lines: (1) training the muscular sense[1] whereby the child knows whether or not he is in the correct position and is able voluntarily to assume it; (2) strengthening by exercise those muscles in which weakness allows lapsing into poor posture. These two lines of development were explained for home conditions in a previous chapter, but may well be reviewed here with directions for adaptation to school use.

Nothing can be done for posture until the child knows how it feels to stand correctly. He must therefore first of all be put into the correct position.

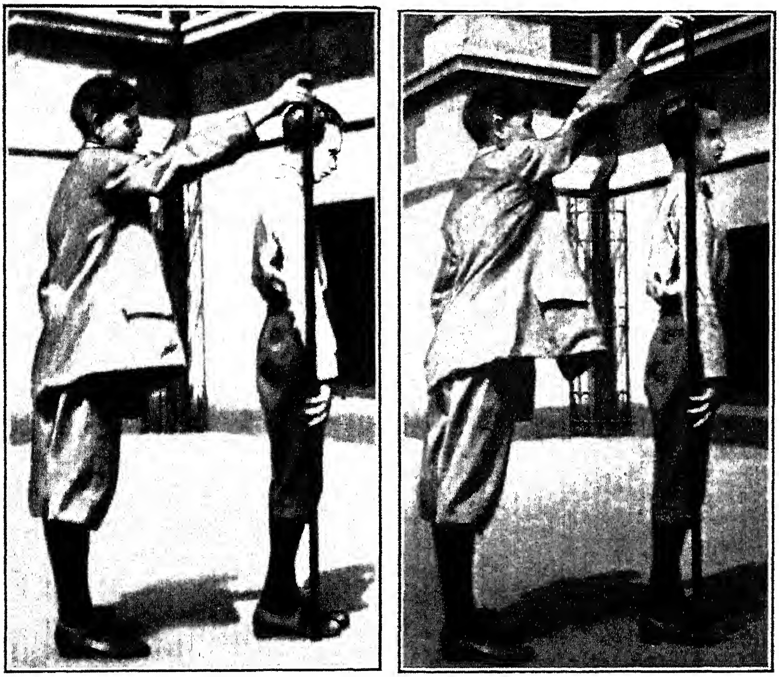
To correct the fatigue position, — the commonest fault of posture, — it is necessary to bring the upper part of the trunk forward without unduly distending the ribs. This is accomplished by action of the joints in the small, or hollow, of the back, — a movement that will be found to correct in nearly all cases the position of the chest above, and the pelvis below. The only parts that may then still need attention are the shoulder blades and the neck (head).

[1] See Appendix, Note 10.

Gainsborough

PLATE XXII.—THE LADIES MARSHAM AND HONORABLE CHARLES MARSHAM.
(Collection of Lord Rothschild. By courtesy of Braun & Co.)

Just what is meant by bringing forward the upper part of the trunk will be seen by reference to Figs. 74 and 75. There it is apparent that in the poor position the chest is back of the vertical line; the correction is made by bringing the entire upper part of the body forward. By actual measurement the abdomen



FIGS. 74-75.—Testing posture with a window pole.

is not retracted in the corrected position, the distance between the front of the belt and the window pole (which serves in the illustration for the vertical line) being the same in both pictures. There is increased tension in the abdominal muscles, but this is incidental to getting the upper part of the body in position, and no instructions will be necessary for the position of hips or abdomen.

CLASS CORRECTION. — These corrections may be made for many pupils at once by means of a class exercise as follows: Have the entire class stretch the arms strongly sidewise at shoulder level, with palms turned downward (Fig. 42). In this

FIG. 76. — The hands placed for pushing the upper part of trunk forward.

FIG. 77. — Another view of the method of correcting the position of the trunk.

position the pupils should sway forward from the ankles so that the weight is nearly or quite over the balls of the feet. Care should be taken that this swaying is not misinterpreted as a bending at the waist or hips, but is done literally by the ankle joints. Swaying backward and forward in this position a few

times (not rising on toes) will be found helpful through its contrast of the two positions in which the weight may be carried. The stretch of the arms, combined with the swaying forward, brings the chest over the toes, and the arm position corrects the shoulder blades. If heads droop, a further instruction to draw the neck or head backward (with chins drawn inward if necessary) may be desirable. Holding this position for the weight, chest, and head, the class should then drop the arms to their natural position at the sides. This should leave a considerable number of pupils in the correct standing position.

Fig. 78. — Correcting the head and neck positions by pushing in the chin.

Individual corrections. — After the class exercise just described, there will doubtless still remain a considerable number of pupils who need individual help in assuming the correct standing position. For faults in the drooping or fatigue position, this individual help may best be given with the pupil

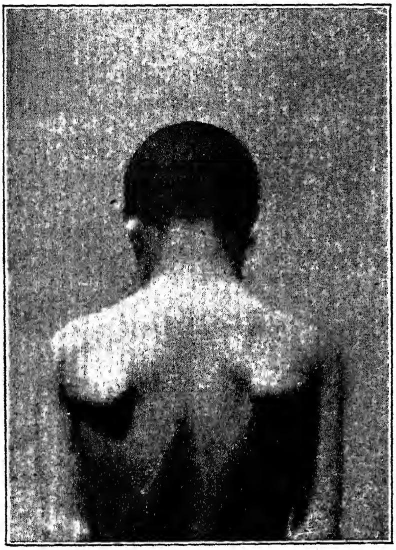


FIG. 79. — Wing shoulder blades on a child of twelve.

standing in profile to the teacher. If the upper part of the spine be backward, or the chest depressed, the correction should be made by placing one hand, or a book, at the waist line in front to steady the body, and with the other hand at the back over the shoulder blades, pushing the upper part of the body forward (Figs. 76 and 77). The head and neck positions may have to be assumed by a direct effort on the part of the child, or even by assistance from the teacher, as shown in Fig. 78.

The shoulder-blade position, which, if hidden by the clothing, may be judged for extreme cases by the ear test described in Chapter IX, and also by feeling for the flat back, may need further assistance from the teacher. In very thin children the lower angle of the shoulder blades may sometimes be felt even when the blades are lying flat on the back; in such cases the one simple

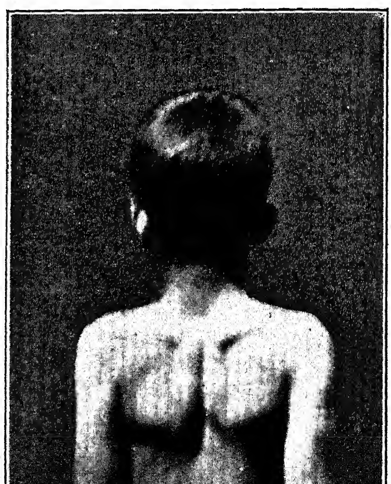


FIG. 80. — The same boy voluntarily contracting the shoulder-blade muscles.

requisite of flatness determines the correct position. In Fig. 81 a prominent shoulder blade and its oblique (improper) direction are both indicated. The correction may best be made with the pupil standing with back to the teacher. She should then place one hand over the round of each shoulder and draw the shoulder blades backward and inward toward each other, flattening them on the back (Fig. 83). After being once assisted to this position, pupils readily acquire the power to adduct the shoulder blades voluntarily. In Fig. 80 is shown an extreme effort at correction of protruding shoulder blades; in a normal position these do not come so close together nor touch each other.

FIG. 81. — Feeling through the clothing (with lower hand) for wing shoulder blades. The upper hand indicates the direction in which the shoulder blade lies in such faulty development.

For throwing outward of the ribs or stomach in a mistaken effort to enlarge the chest, an entirely different method of correction is necessary.[1] This position may always be detected by the exaggerated outward curve of the front of the body and the

[1] See Appendix, Note 11.

extreme hollow in the small of the back. The close association of spine and ribs, which leads to this position, also indicates the best means of correction; this consists of having the child relax the distended ribs (Fig. 84), when the back (lumbar spine) will be seen at once to resume a normal outline.

FIG. 82.—The ear test for shoulder position.

It will be seen that with these methods of correcting posture, many old stereotyped phrases have been dispensed with. The terms "chest high," "chest large," "chest forward," "lift the chest," "hips back," "abdomen in," or "shoulders back" are associated in almost every case with some exaggerated muscular action that, instead of producing good posture, corrects one fault by producing another (see Fig. 73). The first four phrases lead to the static distention of the ribs and the hollowing of the back that has been called the "bantam" or "pouter pigeon"

attitude; the next two lead to an exaggerated tilt of the pelvis; and "shoulders back" is an old enemy of good posture for its cultivation of a sway-back position of the entire upper part of the body.

Pupils should understand exactly what they are expected to do, and phrases that more exactly describe this may be found useful. The moving forward of the upper part of the trunk, for instance, may be assisted by the command, "Chest over toes."

FIG. 83. — Placing the shoulder blades in position.

POSTURE DRILL. —Having thus assisted each pupil in a class to assume the correct position, the next point of importance is to train the power to take this position independently; for this, pupils must learn to discriminate by their own muscular sense between the feeling of the correct position and their habitual poor posture. To this end a little drill on losing and resuming the correct position has been found of utmost service. The pupils are told to lose their good standing position; in short, to relax into any habitual, or relaxed, or exaggerated posture they

may choose. After a very brief moment of this relaxation they are given the command, "Position!" and immediately resume the new (good) attitude. This is repeated three or four times in quick succession, the teacher inspecting the lines each time and assisting those pupils into position who have not yet acquired the full sense, or power, to assume it independently. This little posture drill on losing and taking the good position should be given as a systematic feature of every lesson, at its beginning and between exercises, when pupils are seen to be losing correct form in the execution of movements.

FIG. 84. — Getting a child to relax the distended ribs of the over-corrected position.

This posture drill, by the use of the principle of contrast, trains the muscular sense and brings control, whereby it enhances the corrective element in gymnastic lessons. It unquestionably serves another very useful purpose by giving a few moments' relaxation to pupils whose good standing position is still so far from natural that considerable muscular effort is required to assume or maintain it.

Thorwaldsen

PLATE XXIII.—HOPE.

CHAPTER XXI

HOW TO CORRECT POOR POSTURE IN THE CLASSROOM: CORRECTIVE EXERCISE

A PUPIL who has acquired the power voluntarily to assume correct position, as described in the previous chapter, or even to hold it for a time, has by no means achieved it as a permanent characteristic. The very fact that he has had habitually poor posture indicates weakness in important muscles, and an habitually faulty coördination between the different muscle groups. For instance, where the shoulders habitually droop forward, muscles on the back that should pull the shoulder blades backward are weak. Nothing can permanently overcome this fault of posture but exercise that will contract so definitely and repeatedly those particular muscles that their tone and elasticity will be improved and they will become permanently shortened. While an effort of the will, as in the posture drill, may accomplish this same end for a few moments, the position is held at the expense of a greater neural stimulus than is needed by a healthy muscle, instead of being done by the contractile power of the muscular fibers themselves. These weak muscles can be cultivated only by exercise, which offers the only permanent cure for such a condition.

This applies to every fault of posture from head to foot. When the spine is in a faulty position, there is weakness in the erector muscles that hold it in the normal attitude, and only exercise that restores the right position will reach these muscles and strengthen them. When the head is too far forward, there is

weakness in the muscles on the back of the neck that should hold it in place. Nothing can make the correct position permanent but repeated, definite exercise of those particular muscles.

It therefore becomes of paramount importance that every course of study in gymnastic exercise for schools should contain a large percentage of corrective exercises. There are hundreds

FIG. 85. — A biology class. The molding influence of the high school.

of gymnastic exercises that are pleasing to the eye, and that make a pretty show when a class drills, that are not corrective; indeed, they may cultivate poor posture. This does not mean, however, that such exercises may not serve some other purpose than postural correction. The corrective value of an exercise is often so closely associated with physiological results that the exercise is equally valuable for either purpose, and neither one may be said to predominate. This is explained in the chapter on home

exercise, where several exercises are described that are equally good for both postural and physiological effects.[1]

A large number of carefully selected corrective exercises is not, however, the only requisite for improving posture. These exercises must be taken (1) according to a method that favors the cultivation of new habits of coördination, and (2) with careful attention from the teacher to the basic posture and general form of execution of each exercise. These points should be considered separately.

NEW HABITS OF COÖRDINATION. — Equally important with the cultivation of strength in weak muscles is the establishment of correct habits of coördination in the various muscle groups. To illustrate briefly, in the habitual fatigue position the muscles on the front of the body are too much contracted, and those on the back too much relaxed. So habitual has this relation become, that it feels to be right, and in anything the individual does, the faulty relation between these groups will be maintained. Whether he walk, or dance, play games, or be otherwise active, his bad posture will always be present. To overcome this, new habits of coördination must be established; the muscle groups must be habituated to working together with a different proportion in their pull and effort.

Illustrations of faulty and corrected coördination are shown in Figs. 86, 87, 88, and 89, which give an upward stretching from a "setting up" drill. This exercise is supposed to stretch the cramped muscles on the front of the body, expand the chest, and serve as a general corrective for faulty posture of the trunk.

[1] By physiological effects is meant the rapid stimulation of circulation, respiration, and related functions, a stimulation that comes through exercise of the large muscles of the trunk or thighs or through precipitant exercises, such as running or jumping.

In the first picture is shown an "informal" execution of the movement in which no attention whatever is given to form. The result is that the old coördinations of poor posture assert themselves, and every fault is cultivated and aggravated, including the exaggerated curves of the spine, and the bad positions of chest, head, and shoulder blades. In Figs. 87 and 89 this

FIG. 86. — Upward stretching that distorts the posture.

same exercise is taken with careful attention to form, and as a result it trains new habits of coördination. The harm that may accrue from faulty execution of exercises was well illustrated in the classes where the new efficiency methods were afterward worked out, by a rapid decline in posture which followed the systematic use three times a day of this informal mode of upward stretching This form of stretching — or lack of form — was part of a two-minute drill that led to a rapid and very perceptible deterioration in posture until the low percentage was

reached at which the efficiency methods first found it. A change to the correct form for the upward stretching here illustrated was one of the features of the new methods, and helped to overcome in a few months a very large amount of lordosis.

The establishment of new coördinations is, therefore, one of

FIG. 87. — Upward stretching that tends to cultivate good posture.

the most important elements in correcting posture. It can only be done by the pupil's consciously directing each movement into the right form of execution. Such conscious direction comes only through one type of work — gymnastic exercise, as distinguished from recreative forms of exercise (games, athletics, folk dancing, etc.). Further, this gymnastic exercise must be taken in response to such signals, commands, cues or admonitions that each movement has conscious, definite direction of its muscular coördination, and is finished to a full terminal position. The

most effective method for insuring such work is what is known as command or response work as distinguished from rhythmic modes of execution. By response is meant a mode of execution whereby each movement in an exercise is a response to some signal, as a count or cue (word). In rhythm the terminal positions, which, rightly taken, accomplish the only definite results for posture, are slurred and weakened, unless the rhythm be robbed of its most characteristic qualities and benefits, by incessant admonitions from the teacher.[1] Rhythm is essentially an automatic process, and its tendency in exercise, as in everything else, is to continue old habits of coördination.[2]

To prove the effect of rhythm, one has only to observe a gymnastic exercise taken first to response or commands, and then to rhythm. In the latter mode, joints that should be fully extended are relaxed; bendings that should be deep become slight; in short, the movements are slurred and lack that definiteness, force, finish, and precision which alone can establish new coördinations and give definite exercise to weak muscles. It may also be noted in passing, that in most gymnastic work (other than with the heaviest apparatus or of the precipitant type) such form and precision are equally necessary to secure physiological effects, for these come best from the strong muscular contractions of finished movements.

Assuming, then, that one has the proper material and method (corrective exercises taken to response or command), it is a mistake to think that these exercises will of themselves pull the body into the right position. The matter is better stated in just the reverse form: if the body be held in the right position, corrective

[1] The only possible exception is in circular movements, such as club swinging, but even here constant admonition is necessary to counteract the automatic tendencies. See Bancroft, 4.

[2] Lagrange, 82.

exercises will correct, — *i.e.* they will contract properly the particular muscle groups that they are designed to affect; but if the body be in faulty posture when these exercises are taken, they will not only fail of their effect, but will cultivate and aggravate the very faults they are intended to overcome. This brings us to the final and most critical requisite for correcting posture.

ATTENTION TO POSTURE AND FORM DURING EXERCISE. — If corrective results are to be obtained, a teacher must observe her pupils throughout a lesson in gymnastics to see that they hold the correct lines of posture. The grouping of the children for posture here proves of especial value, for it admits of group teaching. While the entire class exercises in response to the teacher's commands, she may concentrate her attention upon that group which is having the greater difficulty to maintain its posture, and assist, personally or with admonition and direction, those who yield to the old muscle habits.

For example, in the accompanying illustration (Fig. 90) is shown an abdominal exercise that, if taken properly, corrects also the position of the entire spine, flattens the shoulder blades on the back, and brings the chest into admirable relation to the rest of the body. Without attention to correct form or position in its execution, this same exercise, as shown in Fig. 91, fails in its work for the abdominal muscles, and aggravates every other fault, whether of spine, head, chest, or shoulder blades. The correct form has been achieved by the child through a conscious effort to keep his back, head, and arms from drooping; in other words, through his effort to contract the weak muscles for the benefit of which the exercise is largely taken. This exercise should never be taken in a standing position. The atrocious posture so cultivated is well shown in Fig. 11.

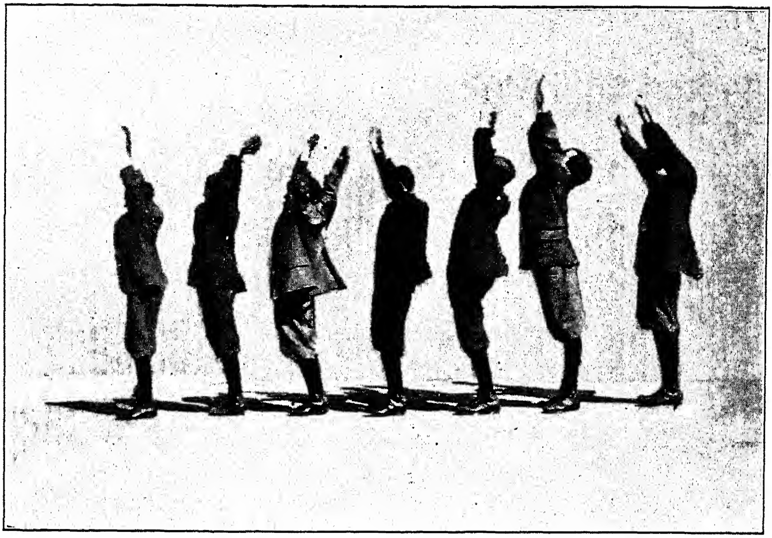


FIG. 88. — A group of boys stretching upward "informally."

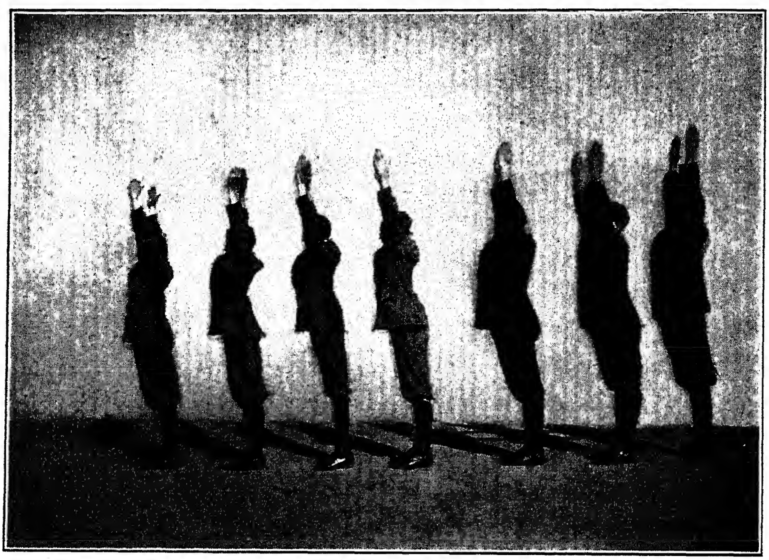


FIG. 89. — The same group stretching with attention to form.

Figures 92 and 93 show another exercise in which the teacher's watchfulness will decide between help or harm for posture. From a position forward the arms are bent and drawn backward at the sides to adduct and flatten the shoulder blades, also bringing the chest, and, through resistance, the head, into good posi-

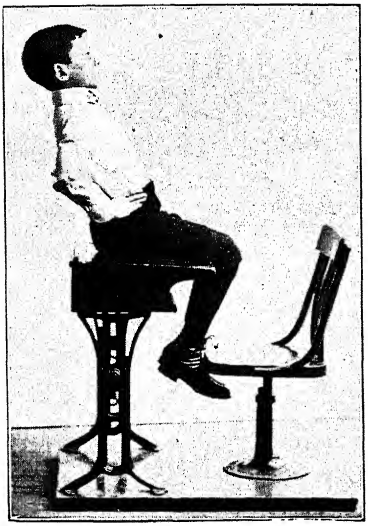


FIG. 90. — An exercise performed so that it corrects posture. (*This and three illustrations following by permission of D. C. Heath & Co., from Bancroft's "School Gymnastics."*)

FIG. 91. — To allow this cannot be called "teaching."

tion (Fig. 92). In the companion cut, inattention to the position of the elbows has led to rounding the shoulders still farther forward with accompanying protrusion of the shoulder blades behind; the head has been thrust forward and the chest retracted.

The execution of corrective exercises so that they do correct is the object of all gymnastic work for posture. It is the only means of developing weak muscles and changing faulty coördination. It is the test of a teacher's teaching ability, and shows at once

whether she merely gives commands, or uses each exercise for accomplishing some definite purpose with each pupil.

The efficiency methods described in this volume have been found to enhance greatly the corrective values in gymnastic teaching, for they lead to observation of the individual child in a way that the usual class exercises never do. The teacher learns to observe the lines of posture throughout a lesson.

FIG. 92. — Correct position.

FIG. 93. — Incorrect position.

Pupils should always know the purpose of each exercise, and work consciously and definitely for the desired result. For instance, when an exercise is intended to draw the shoulder blades together on the back, the pupils should know that fact and should feel the exercise at the place indicated. This intelligent effort on the part of pupils should enter into their execution of all exercises.

In any discussion of exercise for a school curriculum, the

fact should never be overlooked that correct posture is only one of many lines of development for which school exercise should provide. Other types of activity than formal gymnastics are needed for these other purposes; but where large numbers of pupils have to exercise in very limited space and time, the formal gymnastics often become the only possible means also for physiological stimulation. Their training of inhibition and prompt reactions through response to commands is also one of their most helpful functions, the value of which has many times been demonstrated in fires and other school emergencies.

No physical education, however, can be considered balanced which is confined to the formal types of exercise, however essential those may be. Recreative forms are as necessary for distinctive purposes of their own — such forms as games, folk dancing, dramatic or imitation activities (mimetics and story gymnastics), and athletics, which include not only track and field sports, but all outdoor exercise, such as walking, skating, swimming, etc. These recreative forms of exercise often give a larger physiological stimulus, an emotional outlet, and an opportunity for initiative on the part of the child than can be had in formal exercise. The psychological and social training of recreative forms of exercise are invaluable, and no program of physical education could be considered complete without them. Their greatest limitation lies in their lack of power to cultivate erect posture, aside from the indirect aid that general vigor may contribute to that end. For this reason, recreative forms of exercise can never afford an adequate physical education for a large majority of children. The formal (corrective) cxercise and the recreative are both needed for balanced development.

CHAPTER XXII

SUMMARY OF EFFICIENCY METHODS

THE efficiency methods for posture described in the previous chapters may be summarized as follows: —

POSTURE SHOULD BE JUDGED by the vertical line test for the body as a whole, and by the flat position for the shoulder blades. Using this method for judging the posture at each step, —

THE TRIPLE TEST should be given to each class once a month. This triple test consists of trying the child's endurance for holding good posture by judging the carriage of the body in —

1. Standing position.
2. Endurance marching (four or five minutes).
3. Gymnastic exercises.

GROUPING. — All pupils who hold good posture through all three parts of the triple test should stand grouped for each gymnastic lesson, forming Division I. Pupils who do not pass the test should stand in another group, called Division II. Any pupils who need to change places to accomplish this grouping should do so at the beginning of each gymnastic lesson, and return to their own seats at the close.

GROUP TEACHING. — Both groups should take the physical training lesson at the same time, but the teacher should concentrate her attention largely on Division II, giving such individual help as may be needed by the pupils in that division. This group teaching should embody the following points: —

(*a*) Each pupil should be put in the correct position and trained to assume it voluntarily.

(*b*) A posture drill (losing and assuming correct position several times in quick succession) should be taken at the opening of each gymnastic lesson and several times during the lesson. This trains the child's muscular control and his muscular sense of position by using the principle of contrast. It also gives momentary relief to weak muscles that may be held in unusual tension.

FIG. 94. — General contours are easily apparent despite the clothing.

(*c*) The gymnastic exercise should bring definitely and vigorously into action the muscles that are weak in poor posture, especially those on the back of the neck, shoulders, and trunk, great care being taken that the pupils hold correct posture throughout the exercise. Pupils should understand what the exercises are for, and work consciously for this development.

INDIVIDUAL RATINGS AND PROMOTION. — Pupils who pass the triple test for Division I should be given either the highest rating (A) or a passing mark (B) to be determined by whether or not their good posture is habitual, or subject to slight fluctuations.

Pupils should be promoted to Division I when they can pass

the monthly test, and *their pride and ambition should be roused for this promotion.*

CLASS PERCENTAGES; RECORDS. — Each month after the triple test has been made, the class rating on posture should be figured on a percentage basis, by dividing the number of pupils who pass the test by the total attendance at the time the test is made. This class percentage on posture should be posted on the blackboard and also kept, with the individual ratings, in permanent form. Pupils should know the percentage of their class in posture, and their pride and class loyalty should be enlisted for improving it.

The success of these efficiency methods lies largely in their psychological appeal whereby motive is aroused in the child himself, through his desire for promotion (to Division I) and his pride and ambition in personal and class ratings.

SCHOOL OR SUPERVISOR'S RECORD. — A school record sheet, showing the monthly percentage of each class, is a very important element in these methods. It indicates the condition of the subject in the school as a whole, shows for school and class any progress or the reverse, and indicates for individual classes where help is needed, or praise deserved.

It will help both teachers and supervisors to keep in mind the following questions: —

1. Do pupils stand in posture groups for each lesson in gymnastics?
2. Is grouping revised each month as a result of the triple test for posture?
3. What is the class percentage on posture?
4. Does the class know its own percentage on posture?
5. Does each pupil know his own rating on posture? (A, B, or C.)
6. Are pupils ambitious to be promoted to Division I for posture and to improve the class standard in this subject?

7. Are systematic records kept of class and individual ratings in posture?

8. Can pupils in Division II assume correct posture?

9. Can they hold this throughout the gymnastic lesson?

10. Is the posture drill (losing and assuming good position several times in succession) taken at the beginning of every lesson and two or three times during the lesson?

CHAPTER XXIII

AUXILIARY AIDS

The use of these efficiency methods for posture has led to many devices for stimulating interest in the subject — devices that are familiarly used for other purposes.

HOME EXERCISE has been found very effective in some instances where poor posture did not yield to the regular school training. This exercise is assigned like any other school lesson for home work, but much discrimination must be used as to whether or not the child can perform the exercises with correct positions throughout, as without this power on his part the exercises may augment the faults of posture instead of correcting them. If he possess this ability, a child may well be required to interrupt his study period at home with certain exercises to be repeated a prescribed number of times, preferably before a mirror. Here again the teacher should use careful discrimination in choosing these exercises, selecting those needed for particular faults. Head and shoulder exercises are the ones most commonly needed. For this purpose exercises may be chosen from the regular course of study in gymnastics, or from the table of home exercises described in this volume. The caution may well be repeated — *be sure that the child can hold the correct position while performing these exercises before requiring him to do them alone.*

REQUIREMENT FOR SCHOOL HONORS. — Among the most effective auxiliary helps has been a requirement of good

Macmonnies

PLATE XXIV.—NATHAN HALE. NEW YORK.

posture for various school honors. For instance, where a "school city" has been organized, with a mayor, council, commissioners of departments, police, etc., the eligibility requirements for any of these offices have included good posture, as determined by the triple test; some schools have even required an A in posture for these positions. For monitorships, positions on the "color guard" for flag exercises, and other similar offices, a rating of

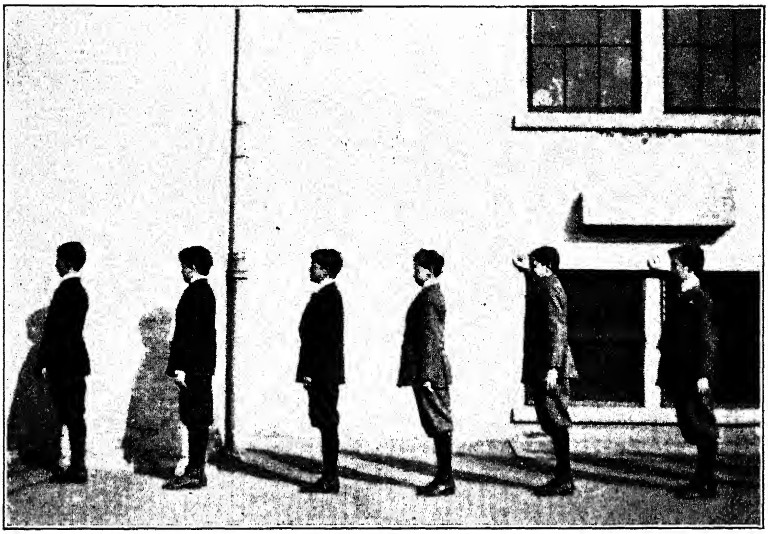


FIG. 95. — A group of well-poised boys.

at least B for posture has been made a condition. It seems eminently fitting that any position that makes a pupil conspicuous should include this requirement. Certainly nothing could injure more the respect of pupils for a good physique than to put in conspicuous positions examples of poor posture.

REQUIREMENT FOR ATHLETIC AWARDS. — After-school athletics for girls have been made another incentive to good posture. Participation in contests for trophies — contests that frequently form the climax of a season's activities — has

been made conditional, among other requirements, on a rating of at least B in posture. For admission to the athletic clubs no requirements are prescribed by the general organization controlling athletics, admission requirements being left to the discretion of each principal; but any girl to receive final awards must qualify on posture. This requirement was voted on by a large committee of women principals, who agreed that the athletics should recognize such a fundamental requisite of a good physique. In turn, the requirement gives added incentive to the work for posture. It is to be hoped that good posture may be made a requirement for eligibility for boys' athletic contests.

How far-reaching such a requirement may be, is illustrated by the case of one little underfed girl, whose posture reflected the poor nutrition that was due to carelessness or ignorance rather than to want. As a member of a school athletic club, the child had looked forward through a winter of folk dancing and games to the culminating contest. But, alas! her little drooping head and chest would not stay in position for more than a few minutes at a time, and it seemed that she must surely be barred from the meet. Finally, the hitherto indifferent mother asked the school principal "what she could do for Amorita's posture so she could take part in the athletic contest." "Milk!" said the principal. "Feed her on good milk several times a day, and let her have oatmeal and other nourishing food." The directions were carried out, and in two months little Amorita was so improved that she helped her club to win a trophy, and received a victor's pin for herself.

ASSEMBLY EXERCISES have been made useful for stimulating interest in posture development. In some schools, while classes march in and out of assemblies they pass in review before

an official, and honorable mention, or other award, is accorded the class having the best posture. Class percentages in posture are read each month from the platform, or special mention made at assembly exercises of the class in each grade or department that has exhibited the highest percentage or made the greatest gain.

BANNERS; TROPHIES. — In some instances a banner or pennant is awarded for the month to the class having the best record in posture, or to the one that has made the greatest gain. One school secured a class trophy which goes each month to the record class; at the end of each term this trophy is engraved with the name of the class reaching the highest percentage (or highest average percentage in case of a tie).

BADGES AND PINS. — Several schools have given a tiny ribbon bow made in class, or school, colors to each pupil in Division I for posture, and one zealous teacher furnished emblematic pins instead of bows.

TRAINING JUDGMENT OF PUPILS. — Various methods have been resorted to for making the pupils themselves more discriminating in the recognition of good and poor posture in others. In one school where it is customary for one class to furnish entertainment for each assembly, although these exercises themselves are not competitive, the posture of the pupils presenting them has been made a subject of vote by the assembly. This vote determines which class shows the best posture for each month or term.

In another school, posture monitors are appointed for each gymnastic lesson for each line or file of pupils. These monitors inspect the posture at the beginning of each physical training period. A monitor's classmates stand in a given aisle, and he walks rapidly down an adjacent aisle making the necessary

corrections. When he has finished, the file in question sits and the next monitor goes down the vacant aisle and reviews his own file. Any pupil in a given row of seats may be called upon to serve as posture monitor for that row, the teacher endeavoring to train all pupils by this service to discriminate in their observation of this subject.

In some schools, monitors for stair or hall duty have been asked to review posture, as well as to look after the usual monitorial duties in conduct or discipline.

In a high school, pupils of each class were asked to vote once a month on the question of which of their classmates had shown habitually good posture throughout the month. It is significant that the highest percentage of good posture was reported for the freshman class, just promoted from the elementary schools where the efficiency methods herein described had been put in use within a year.

DRAWING AND COMPOSITION. — Good and poor posture have been made subjects for drawing and composition, with results that were undoubtedly beneficial to the children and often amusing to their elders.

HOME REPORTS. — The custom of making posture a special item on report cards sent home each month is spreading rapidly, and has led to excellent coöperation and much appreciation from parents. Like most things, it has its humorous side. One irate mother came to a school to protest against her son's being rated on his "looks." "He doesn't come to school," she said, "for his looks." It took some time to convince her that in this case health and looks were one.

PROMOTION AND GRADUATION REQUIREMENTS. — In the New York City schools posture is noted in the estimate of a pupil's proficiency for promotion from grade to grade, and

each pupil's posture is rated in estimating his fitness for graduation from the elementary schools. Until the efficiency methods described in this volume were adopted, as many types of posture were passed as "good" as there were teachers or principals. The triple test has at once standardized the subject so that a rating of A, B or C, carries a definite significance.

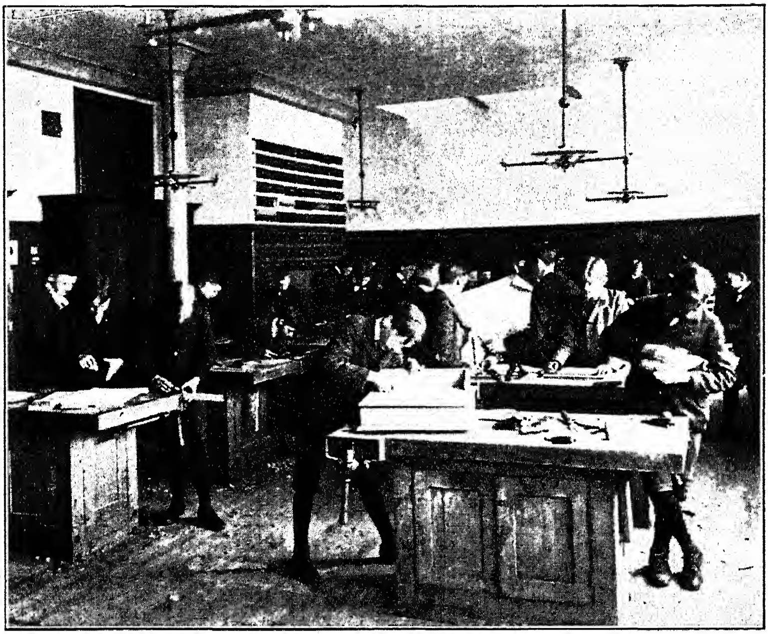


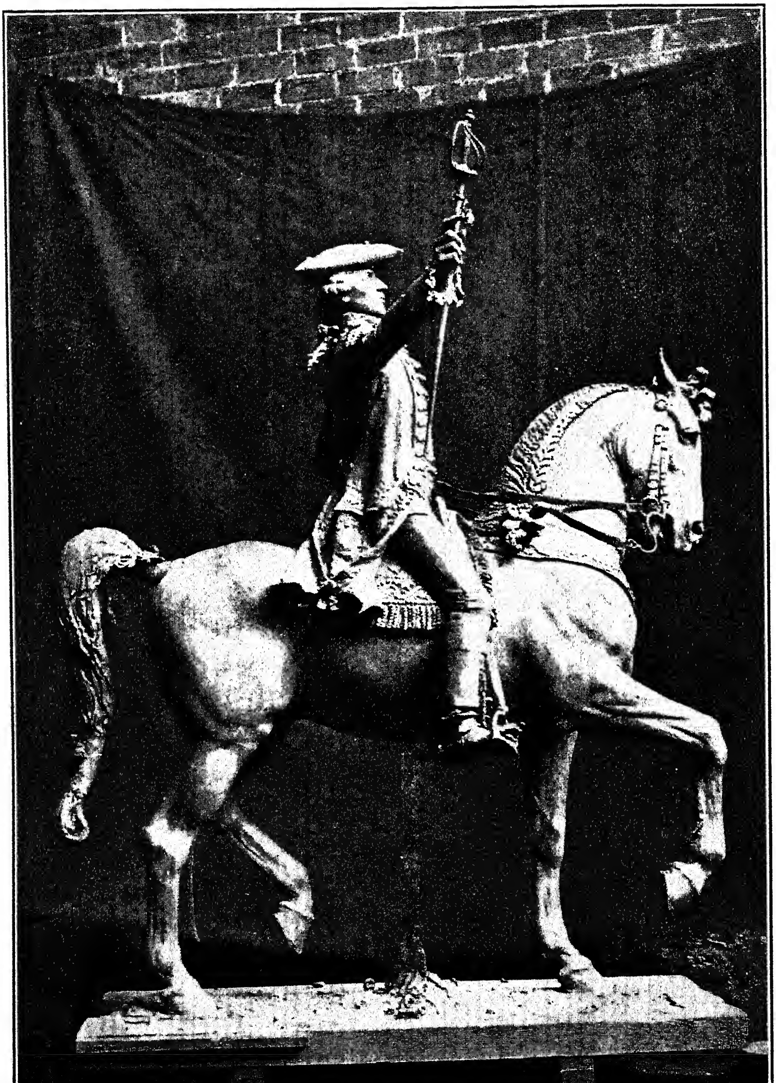
FIG. 96.— Even in the manual training lesson careful work means inevitably stooping positions.

PUPILS' INTELLIGENCE ON THE SUBJECT. — Above all, children should be made intelligent not only as to the points of good posture, but as to the reasons for it. They should know that good posture gives room for the lungs to act and to grow, helping to strengthen them so that they can resist disease, and properly purify the blood; that the heart and general circulation, the stomach and digestion, are all better when the organs con-

cerned are given proper room for their work. They should know that in poor posture the opposite of all this is true. Children are always interested to know that in good posture they have their greatest height and that poor posture makes them shorter. With occasional cases of overgrown boys and girls, who are mortified by their height and shrink into poor attitudes to hide it, the power and advantage of large proportions should be set forth in private conference and a pride aroused in a physique that may be magnificent with correct carriage or ridiculous without it.

POSTURE AN INDICATION OF CHARACTER. — The different impressions of intelligence and energy conveyed by good and poor posture are readily appreciated by children if illustrated for them, and the importance of these in business or social life appeals especially to the older children, many of whom expect to apply for positions when they leave school. The pride of personal appearance has also a legitimate appeal to older pupils; and girls may well learn that the effectiveness of a gown depends less upon its elaboration than on the way it is carried and worn.

EXAMPLES OF GREAT MEN AND WOMEN may be effectively used in appealing to the intelligence of the children, and frequent illustrations may be found in portraiture and ideal art. One class of boys and girls who selected "Queen Louise" as a class picture, gave as their reason, "Because she stands so well." With pictures of Washington and Lincoln before them, of kings and queens, of pioneers and heroes, who figure in history and literature, it should not be hard to inspire any child with a desire for the best carriage he can cultivate.



Bartlett

PLATE XXV. — LAFAYETTE. PARIS.

CHAPTER XXIV

THE SCHOOL HYGIENE OF POSTURE

Erect posture is at all times closely related to physical and mental condition. Indigestion, weakness of the respiratory organs, lack of sleep, worry over examinations or promotions, any form of nervous or mental depression, — all show in the carriage of the body, which in turn may aggravate or alleviate the physiological conditions. It seems especially deplorable that in addition to these general influences, a growing child, who is establishing his habits of posture for life, should be subjected to the almost constant adverse influences of school life. For it is a fact that almost every school occupation, except physical training and singing, tends to induce poor carriage of the body.

The sedentary nature of its work is the school's first and most persistent enemy to good posture. For this an adequate amount of exercise, selected for definite purposes, is the only remedy.

"In consequence of the neglect of the elementary school to make provision for physical exercise, many of the pupils come up to the secondary schools with drooping heads, flat chests, projecting shoulder blades, and other school bench deformities, which must be attacked at once if they are ever to be corrected. Physical defects are so common during the early teens, and they are so easily overcome at this time, that the whole school class should be put through a daily systematic drill with a view to counteracting the evil effects due to the confinements and restrictions of schoolroom life." [1]

[1] Sargent, 122.

From the third year up, most school children sit at least eighty per cent of the school day, or more than four hours out of five. Leaving aside entirely the effect on physiological processes, which become sluggish through the physical inaction, the immediate effect on posture is readily discernible.

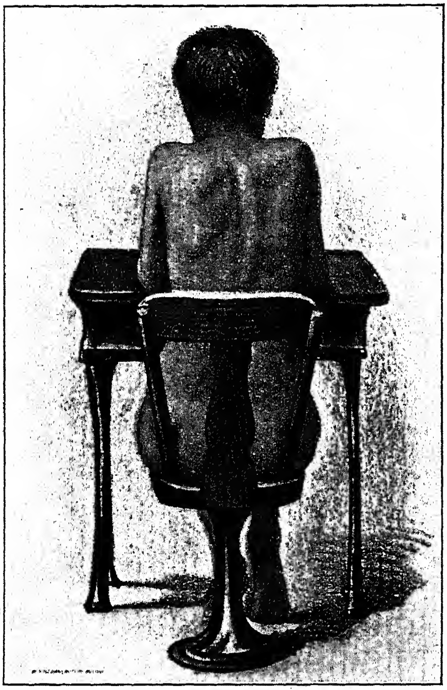


FIG. 97.—Shoulders thrust upward by too high a desk. (*Courtesy of Dr. Scudder.*)

Sitting is, in itself, a partial relaxation, and its tendency, long continued, is to cultivate habits of general relaxation and lazy, lounging attitudes. So habitual do these become, that without constant admonition from the teacher, pupils lounge against the furniture when they stand to recite, and usually show carelessness of carriage in marching for assemblies, dismissals, change of classrooms, etc. Moreover, most school occupations call for close application of the eyes (Fig. 97) and also of the hands and arms in front of the body. This leads to contraction of the chest, and drooping forward and downward of the head and spine. Reading, figuring, drawing, map study, sewing,—all call for these positions; writing, however carefully done under the most approved methods, inevitably tends to the same faults:

even manual training, which is supposed to give physical relief and activity, continues these same attitudes of close application, which are none the less harmful because the child is on his feet. These conditions are an inevitable and necessary part of the occupations mentioned, and it therefore becomes of paramount importance to counteract them with frequent and sufficient exercise, and to observe with utmost care all related points of school hygiene that bear upon posture.

Fig. 98. — Crouching attitude induced by too low a desk. (*Courtesy of Dr. Scudder.*)

Adjustable school furniture is a fundamental consideration.[1] The person who will invent a device for easily adjusting school desks and chairs will confer one of the greatest possible benefits on humanity, for where adjustable school furniture is supplied, the difficulties of adjustment almost or quite nullify its possible usefulness.

The effects of misfit school furniture on posture are shown in the accompanying cuts from well-known studies by Dr. Scudder of

[1] Hartwell, 61; Scudder, 125; Shaw, 126; Cotton, 25; Stecher, 129.

Boston. If the desk be too high, the shoulders are unduly elevated and the head and chest forced out of position (Fig. 97). With a desk too low, the worst possible crouching attitudes are cultivated (Fig. 98). A chair too high leads to sliding down in the seat in an effort to touch the feet to the floor, and this rounds out the back and tilts the pelvis too much toward a horizontal position; with a chair too low, the upper part of the body collapses into the most aggravated "fatigue position."

A properly adjusted chair has the seat at the height of the bent knee when the foot rests flat on the floor; this places the thigh in a horizontal position. The desk should be of such height that when a pupil is seated as above described, and the elbow bent, the forearm will rest horizontally on the desk surface.[1] The distance between desk and chair, affecting as it does the leaning forward of the pupil to work, the slope of the desk top and relation of the desk to the light, the shape and inclination of chair back and seat, are all matters that influence the posture of children. The Boston School House Commission has recently designed a school seat and desk in which all of these points have been considered, though perhaps not finally settled.

The strain put upon the eyes or ears of children defective in vision or hearing is reflected strongly in posture, as shown in the almost inevitable protrusion forward of the head in such cases. This adds another to the many arguments for attention to these points of school hygiene and for seating pupils according to powers of sight and hearing, that the strain may be minimized.

With perfectly adjusted furniture there still remains the necessity for cultivating habits of correct sitting. This should be with the buttocks pushed back in the seat as far as possible; with this preliminary, the child can then lean back to rest the

[1] If the pupil has to bend forward to work, the desk should be slightly higher.

shoulders without inducing any fault of posture, *if the furniture be shaped to admit of this.* Unfortunately it is well nigh impossible to find such furniture. The Boston model comes nearest to it. Figure 100 shows a temporarily good position in the ordinary school furniture. In this position a child can sit upright at

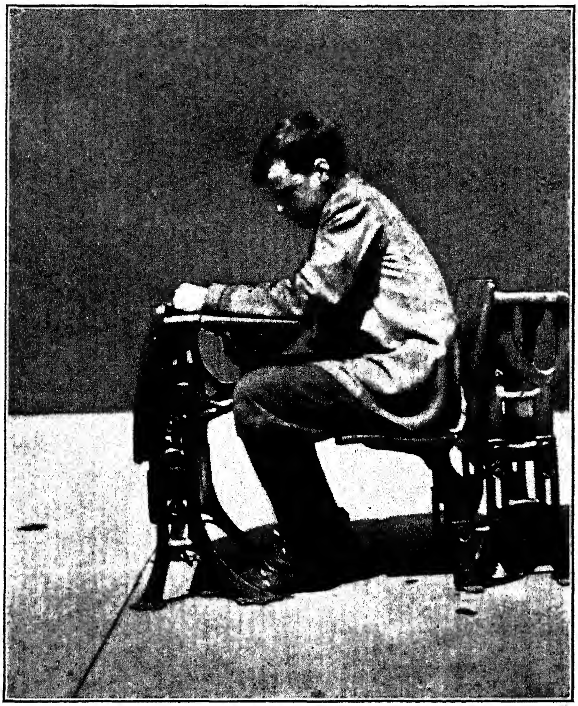


FIG. 99.—A grammar school boy in a primary school seat.

intervals without fatigue. The essential value of this sitting position is that it places the pelvis in its natural relation to the spine, so that the latter is not forced into unnatural curves.

The position of the hands and arms when sitting at attention are of much importance. The best position is with the hands resting naturally in the lap or on the seat at the sides. If for

disciplinary reasons the hands should be in sight, they should be clasped on the edge of the desk, as near to the body as possible, that the shoulders may not be drawn forward, or the chest narrowed by stretching the arms forward.

FIG. 100. — Furniture of the right height.

The habit of folding the arms behind, between the body and the back of the seat, should never be allowed. If the buttocks and shoulders are kept in the proper position, this folding the arms behind forces the spine into the lordosis position (exaggerated lumbar curve); for it is a mistake to think a child has a

hollow in the back sufficient to hold the arms in this way. In the correct sitting position the natural lumbar curve is almost obliterated in children up to thirteen years of age, and nothing could be worse for posture than to force it by this wedging of the folded arms between the child and the chair back. Other

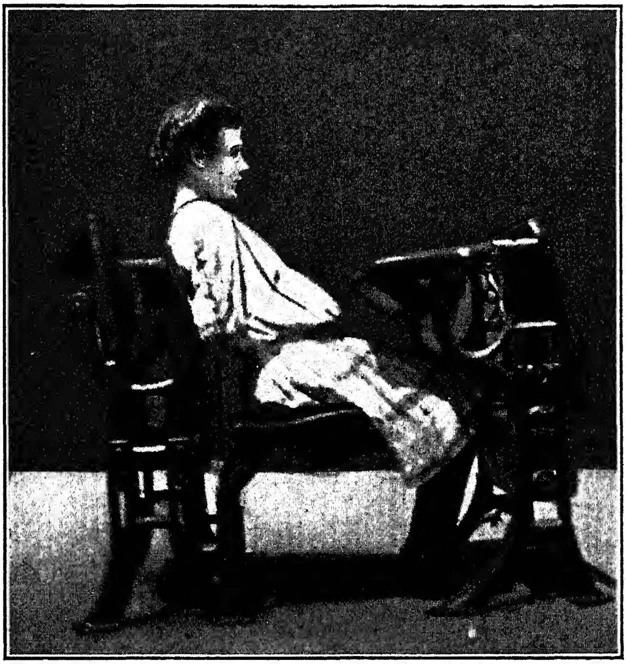


FIG. 101.— Crowded forward in the seat by folding the arms behind.

faults that come from folding the arms behind in sitting are a prying or forcing forward of either the upper or lower parts of the spine, so that the pupil slips forward in the seat (Fig. 101); folding the arms on the chest, or clasping them on or behind the head (Fig. 102). These positions are equally reprehensible for their tendency to drag the chest and head forward.

It should always be remembered that the natural restlessness

of children is a need of their growing bodies, and this need should be respected by allowing natural shifting of positions in sitting. The points essential for avoiding harm, aside from the shape and fit of the furniture, are that the child shall be called to the erect position with sufficient frequency and systematic orderliness to avoid a habit of relaxation or slouching; and, further, that no one position of relaxation shall become a habit. Frequent change of posture in either standing or sitting, and a sufficient alternation of the two, should be among the cardinal principles for the hygiene of posture.

FIG. 102.—A sitting posture that needs no comment.

Writing positions are, of course, of great importance. The best is unquestionably that which calls for the support of both arms on the desk; but no position can do away with the need for much watchfulness and admonition on the part of the teacher during writing exercises. The amount and direction

of light, and even the quality of pens, ink, and paper, affect posture.[1]

The carriage of pupils in standing and marching could be made of great service for cultivating good posture instead, as is usually the case, of allowing careless, slouching habits to obtain. The author knows of more than one school in which great improvement in posture resulted from the introduction of brisk, military methods of marching in and out of the building, in place of a slouching, shuffling passing of classes. A fife and drum corps, or the drum alone, has the same inspiriting effect for such exercises as for soldiers on the march.

FIG. 103. — One-sided position from standing on one foot — "hipping out" (*Mosher*).

FIG. 104. — The correct position for recitation or prolonged standing — one foot in advance of the other (*Mosher*).

Standing for recitations is done so often that it becomes one of the habitual influences of school life. As such it may serve to fix faulty habits of carriage, or be made an effective opportunity for cultivating the reverse. Standing with the feet parallel and the weight equally distributed between them, as described for the vertical line test, is not a position that can be long maintained. The tension on the muscles of the legs is equal, and there is no mode of relief. The usual method of shifting such a

[1] See Abbott, 1.

position is to throw the weight on one foot, the other remaining beside it, though perhaps extended to one side. This attitude is a harmful one, for it leads to a one-sided tilt of the pelvis, with accompanying lateral curvature of the spine, as shown in Fig. 103 from Dr. Mosher. After careful study of the subject, she recommends the position shown in Fig. 104 as one to be assumed for school recitations or to relieve any interval of long standing. In this the weight is thrown mainly on one foot at a time, but the base is enlarged by placing that foot which bears the weight forward of the other instead of beside it. This keeps the pelvis level, and, by changing the feet during periods of long standing, prevents undue fatigue. The position is assumed by stepping slightly forward on one foot while the rest of the body is held upright.

The habit of "hipping out," shown in Fig. 103, does not end with the period of standing. Such a habit shows also in the walk, where almost invariably one foot comes to be planted more heavily than the other, or a one-sided swing is acquired.

Probably no school requirement is more prolific of bad posture than the carrying of books. Could this evil be done away with, a large amount of poor posture would probably never appear, and that which comes from other causes would be much more readily overcome. The schools are rare whose pupils do not carry heavy loads of books for more minutes a day than is given to physical training. In carrying books to and from school, and in changing classes where departmental systems prevail, these loads literally mold the child into a constant distortion of posture.

Boys and girls carry books differently. Ask a class of boys and girls to pack up all of their books and march with them around the room, and it will be found that with few exceptions

boys carry the load at full arm's length far around on the hip, tipping the trunk to the opposite side (Fig. 105), while girls carry the load, as a woman would a baby, farther toward the front, shoving the hip out obliquely forward to meet it (Fig. 106). The boy's high shoulder will be on the side of his books; the girl's low shoulder will be on the side of the books. Both attitudes are vicious and lead to lateral deviations; but with the girl there is added a rotation, by which the antero-posterior curves of the spine are also exaggerated (Fig. 107). *It is well-nigh impossible permanently to correct the habitual posture of any child who is repeatedly distorted with such loads.*

Fig. 105. — Boys and girls carry books differently. The boy's high shoulder is usually on the side of the books, which are carried directly under the arm.

The best way to cure this evil is to stop carrying books altogether. When it is found that five hours a day of close application is enough for a growing child, one need for carrying books home will be done away with. As it is, many schools minimize the evil by having the child use a systematic method of carrying part of the load at noon and part at night. One principal evolved the plan of dividing the load between the two arms, carrying part on each simultaneously; it has worked very successfully (Fig. 108). Another resourceful principal suggested carrying the books on alternate arms on alternate days or weeks. These

methods of carrying books, if systematically carried out, may enable a child to avoid lateral curvature of the spine, but they cannot do away with the antero-posterior faults of posture which are induced by the carrying of any heavy load.

Probably the best school bag for books is the German bag carried on the back like a rucksack, but it seems hard to make

FIG. 106. — The way girls carry books — forward on the hip, a position that leads to a twist in the spine. When long continued, the low shoulder is usually on the side of the books.

this popular in this country. The hand bags or book straps that necessitate carrying the entire weight of books on one side are but slightly less harmful than the unaided arm. A habit of carrying such bags or straps in one hand shows very soon in uneven shoulders.

In cities where school buildings are used for night school, it is common for children to carry all of their books home each night, and the author has found many of these loads to weigh

ten and twelve pounds. It would be perfectly practicable to provide locker room in such buildings for each child. Indeed, every school building, whether for elementary or high school grades, might well be constructed with such lockers placed under the blackboards in the form of drawers. This has been done in the case of one New York high school.

While the topics here discussed have an especially direct in-

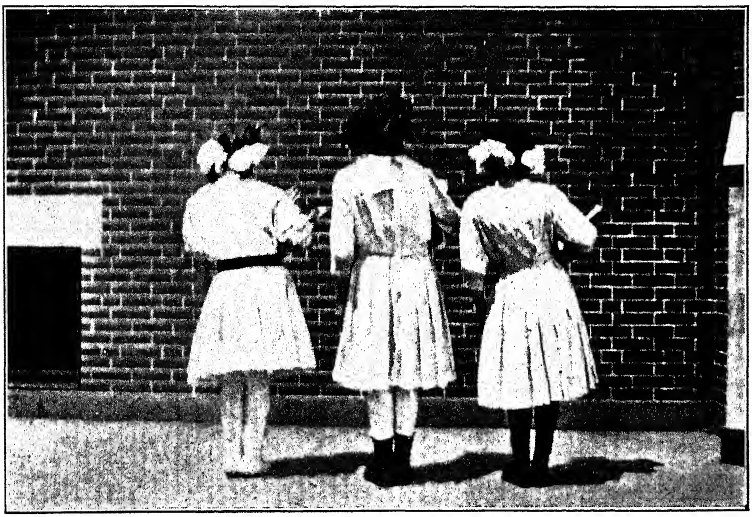


FIG. 107.—Rear view of girls carrying books.

fluence on posture, there is no phase of school hygiene that is not related to this fundamental element of a good physique. Fresh-air classes for anæmic and tubercular children improve their posture at the same time that they raise the tone of other functions of the body. School lunches for the underfed show their effects in posture as definitely as in other ways. A marked instance of the effect of such lunches may be cited. The author's attention was called to a class of between forty and fifty children of the second school year, not one of whom could pass the ear

test for shoulders. It looked as though the test had failed, but an immediate inspection of other classes of the grade in other schools failed to show similar conditions. This school was in a "mixed" neighborhood as to economic conditions, where there was a considerable number of children who might be underfed. About this time the principal inaugurated the custom of serving

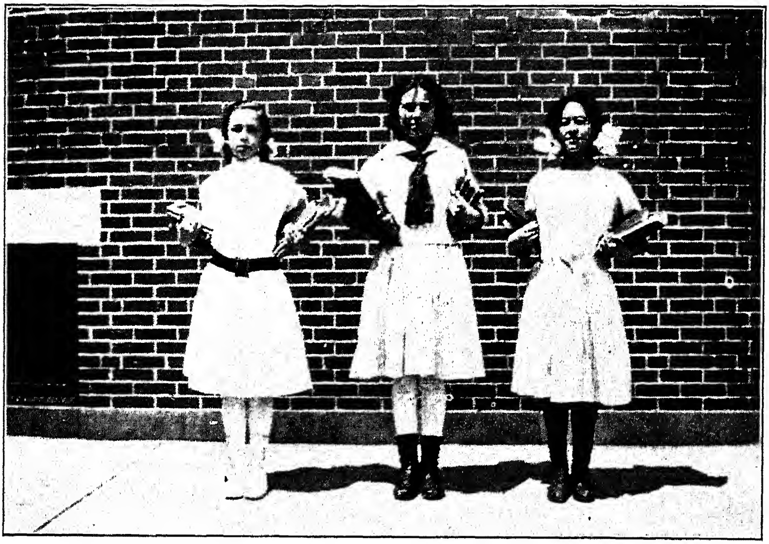


FIG. 108. — Correction of posture by dividing the load between the two arms.

a cup of milk in the middle of the morning session to children in the lower grades, and this was followed by fifteen minutes of "sleeping," with heads on the desks. In a few days a majority of the children acquired the habit of taking an actual nap at this time. The combined luncheon and rest resulted in such an improvement in mental condition as to make the remaining two hours of the session available for number work, reading, or other tasks usually considered suitable only for the early hours of the program. Physically the children responded so rapidly to

corrective exercise, that within a month there was scarcely a child in the class who could not carry the shoulder blades correctly through the triple test. The instance gives pause, with the query, How much would the children gain, and how much would the waste of education be eliminated, by more general use of such simple reënforcement as a cup of milk and a few minutes quiet rest?

All conditions that influence fatigue have direct bearing on posture. In this connection, the question of school recesses is of special importance. The tendency to omit recesses from the school program for grammar grade and high school pupils is open to serious objection. When industrial concerns find it to their financial interest to give recesses to their adult employees, the results showing in improved work and fewer mistakes, it would seem that education, in reducing such recesses, is lagging behind instead of leading the way.

Finally, in all matters of home hygiene the teacher can exert a strong influence. This is shown marvelously in the degree of neatness and personal hygiene often due to the influence of the schools. This influence may well be extended to include the kind of clothing that affects posture, and all of the other influences noted in discussing the home hygiene of the subject. Many teachers have influenced girls to sensible dressing, and many classes of boys in upper grades have been induced to wear shirt waists throughout the winter and sit in the schoolroom without the hampering of ill-cut and heavily lined and padded coats.

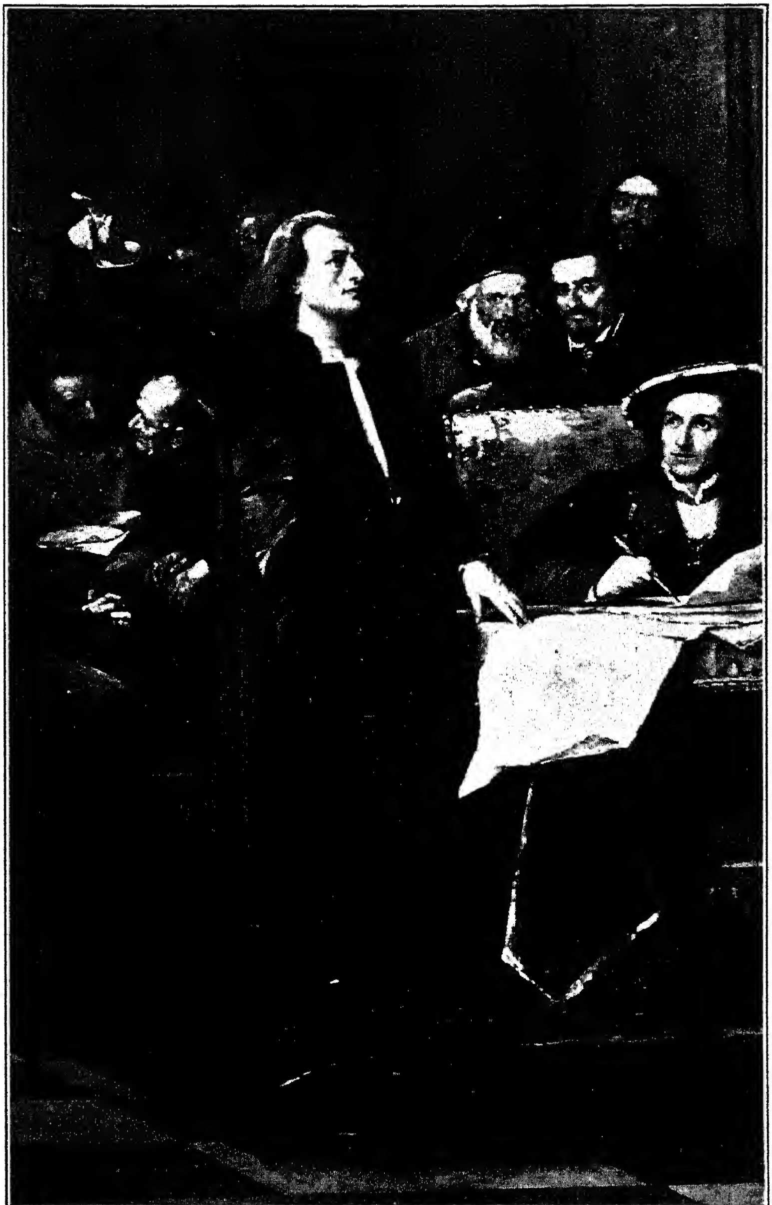
The interrelation of these many hygienic influences serves to emphasize anew the duty of the schools, especially under a system of compulsory education. A child's health and normal development should be, not only *a* fundamental, but *the* fundamental, object of his education.

CHAPTER XXV

ERECT POSTURE AS AN EDUCATIONAL AIM

It has commonly been assumed that erect carriage of the human body is one of those inherent characteristics for which nature cares without any special assistance. To be sure it has always been known that many children as well as adults lapse from a good position; but that these poor positions might be prevented, or that the power to assume and maintain erect posture is at the best a very fragile and uncertain one that should be strengthened, guided, and helped for all children, whether or not their posture deviates from the normal, is a view of the matter that yet remains to be incorporated in our ideas of education.

The details in which proper development of spine, chest, shoulders, and feet should be helped during the growing period have been set forth in preceding chapters. Further reasons why this should not be left to chance may well have a little more consideration. These reasons are inherent in some other facts of a child's growth. First is the pliability of the bony framework, especially during the years of growth. At this time habitual positions, either of rest or activity, may grow into the bony structure beyond power of subsequent modification. The body is literally molded into many of these positions. The skeleton is by no means of the hard and unchangeable substance which common thought ordinarily assigns to it. The habitual strain or pull of muscles, or habitual pressures as of postures, so



Detail from painting by Brozik

Plate XXVI. — Columbus.

(*Courtesy of the Metropolitan Museum of Art, New York.*)

alter the bones as to decrease permanent height, affect the permanent angle of joints, or change the lines and contours of the body. This is especially true of regions that are not ossified during these growing years. For instance, the ribs where they join the spine are not ossified until late in the high school course, or soon after the beginning of the normal school or college (sixteenth to twentieth year of age). Portions of the shoulder joint and shoulder blade are not ossified until the end of the grammar school course or beginning of the high school (fifteenth to seventeenth year). Ossification of the clavicle (collar bone), pelvis, and other parts of the body is similarly incomplete during these school years. Moreover, the bones in childhood are softer than those of an adult, having less lime salts in their composition, and as a consequence they yield with especial ease to constant pressure.

Another element that calls for purposeful education during the growing period is the muscular sense, or sense of equilibrium, which has frequently been mentioned in this study.[1] However instinctive may be the infant's striving for the upright position, the fact that the maintenance of this position may not be relegated for all time to the unconscious nerve centers is plainly shown by the faulty attitudes into which children lapse. One potent reason for this lapsing lies in the rapid changes in bodily proportion during the period of growth. The child's muscles no sooner become adjusted to holding upright a comparatively large head and trunk on short legs, than his legs begin to grow faster than the rest of his body, and soon he is supporting the center of gravity on top of long legs with comparatively small trunk and head above it. Apparently his arms gain in weight faster than the muscles that hold his shoulders in position gain

[1] See Appendix, Note 10.

in strength. The growing period thus becomes a time of continual readjustment, and it is no wonder that the awkward boy or girl knows not what to do with arms and feet, or that he or she fails to establish habits of erect carriage.

The physical basis of education continually receives fuller attention. The need for including in this physical care definite training in erect posture has been but feebly stated in this volume if its importance as a fundamental requisite to health and physical stamina has not been made clear. The time will undoubtedly come when tests for a child's physical condition will outrank in importance any other tests in his education; and it is certainly as practicable at this time to ask if he stands correctly, and if not, why not, as to find out why he goes slowly through the grades, or what peculiarity of mind causes him to stumble over problems in arithmetic.

Walker

PLATE XXVII. — LYRIC POETRY.

(Detail from mural decoration in Congressional Library, Washington, D.C. Copyright by H. O. Walker. From a Copley Print, copyright by Curtis and Cameron.)

CHAPTER XXVI

ERECT CARRIAGE AS AN EXPRESSION OF INTELLIGENCE AND CHARACTER

THAT a person standing erect looks to be more intelligent and energetic than one in poor posture, needs no argument; it is self-evident. Under this appearance, giving it reality, lies the biological fact that the erect position has been coincident with the development of the brain (cerebrum) as it exists in man. While the muscular action necessary for maintaining erect posture is chiefly controlled by the unconscious nerve centers in the cerebellum and spinal cord, the acquirement of this posture by both the individual and the race is largely the result of direct effort by higher brain centers.[1]

That brain development or brain condition bears a direct relation to the erect position, becomes apparent when one considers the collapsed posture and imperfect carriage characteristic of idiots and defectives.[2] In dealing with a general principle like this, however, one must not be led into faulty applications of it to individual cases. For instance, habitual poor posture in a given individual may indicate, not a low order of brain development, but general lack of nervous or other physical power. Barring such pathological conditions, however, it cannot be disputed that erect posture is, as a general principle, an expression of intellect and energy as well as of physical vigor.

Nor are these the only qualities expressed by a perfectly erect carriage; it indicates, also, many of the best emotions and traits

[1] Ross, 117.

[2] Johnson, 76; Trettien, 138; Seguin.

of character, such as cheerfulness, hope, and courage. It is the literal as well as the symbolic attitude of Edward Everett Hale's famous rule of life:—

"Look up and not down;
Look forward and not back;
Look out and not in;
Lend a hand."

The great actors understand well this effect of erect carriage or its reverse in conveying emotions of the higher or lower type. Henry Irving as Matthias, the murderer, was a cringing coward; as Richelieu, Becket, or King Arthur he was drawn up to his full height. Richard Mansfield's Dr. Jekyl and Mr. Hyde were as different in carriage as in character. And then there is the curious fact that the assumption of an attitude expressive of a certain emotion tends to produce the emotion. A man recovering from nervous exhaustion said that when he was breaking down, and would find himself sinking into weak attitudes accompanied by depression of spirits, he would pull himself up to an attitude of courage, and for hours would be able to go on with his work with spirit. This reflex effect of attitude has been enunciated by Darwin and others.

"The free expression by outward signs of an emotion intensifies it. On the other hand, the repression, as far as this is possible, of all outward signs softens our emotions. He who gives way to violent gestures will increase his rage; he who does not control the signs of fear will experience fear in a greater degree; and he who remains passive when overwhelmed with grief loses his best chance of recovering elasticity of mind. These results follow partly from the intimate relation which exists between almost all the emotions and their outward manifestations; and partly from the direct influence of exertion on the heart, and consequently on the brain." [1]

[1] Darwin, 28.

"Movements and attitudes of the body, artificially produced, are capable (in some cases, and to a slighter degree) of exciting the corresponding emotions. . . . Remain for some time in an attitude of sadness and you will feel sad. . . . Emotion excites movements; movements excite emotion."[1]

Professor William James says on this point:—

"Every one knows how panic is increased by flight, and how the giving way to the symptoms of grief or anger increases those passions themselves. Each fit of sobbing makes the sorrow more acute, and calls forth another fit stronger still, until at last repose only ensues with lassitude and with the apparent exhaustion of the machinery. In rage, it is notorious how we 'work ourselves up' to a climax by repeated outbreaks of expression. Refuse to express a passion, and it dies. Count ten before venting your anger, and its occasion seems ridiculous. Whistling to keep up courage is no mere figure of speech. On the other hand, sit all day in a moping posture, sigh, and reply to everything in a dismal voice, and your melancholy lingers. There is no more valuable precept in moral education than this, as all who have experience know.

"If we wish to conquer undesirable emotional tendencies in ourselves, we must assiduously, and in the first instance cold-bloodedly, go through the outward movements of those contrary dispositions which we prefer to cultivate. The reward of persistency will infallibly come, in the fading out of the sullenness or depression, and the advent of real cheerfulness and kindliness in their stead. Smooth the brow, brighten the eye, contract the dorsal rather than the ventral aspect of the frame, and speak in a major key, pass the genial compliment, and your heart must be frigid indeed if it do not gradually thaw."[2]

Obviously, the attitude characteristic of courage, intelligence and nobility may do much to establish those traits and to banish their opposites.

So many eminent men and women have fine carriage, that we have come justly to associate this feature with the highest

[1] Ribot, 116. [2] James, 75.

type of development in the race. The orator who stands in poor posture has much more difficulty to impress an audience than one who stands correctly A commander must inspire confidence by his mien as well as by his words. Men and women in the forefront of any line of endeavor are unusual if their power is not indicated in this way. True, there have been, and are, many people who constitute exceptions to this rule, but such people succeed in spite of a handicap and at an expense of effort and energy that is often tragic for the individual, and wasteful for the world.

Artists usually understand the full value of the erect position, though they often choose the poses of activity or relaxation. Greek sculpture at its best, when free action in the pose of figures had succeeded the stiff, mummy-like erectness of the archaic period, shows erect figures always in the full majesty of their height. The Parthenon frieze, and the pediment sculptures from the Temple of Zeus, show many erect figures, and these are always in the lines of perfect carriage. Other single figures of Greek gods and goddesses owe much of their impressiveness to the loftiness of their bearing. A large part of the wonderful buoyancy and spirit of the winged Victory of Samothrace and of the Nereid group is due in each case to the perfect uprightness of the torso.

The great school of English portrait painters of the eighteenth century was very sensitive to this element, and the peculiar distinction of the men and women who look from their canvases is largely due to their stately carriage. It is almost impossible, for example, to find a Gainsborough portrait that is not so posed. Although the style of costume shown sometimes disguises the lines of the figure, the French, Spanish, and Dutch painters present many other illustrations.

In contemporary art are to be found many examples in which the carriage helps greatly in conveying some of the highest spiritual qualities. Most of the figures modeled by Saint-Gaudens are fairly electric with physical and spiritual uplift. In his Lincoln statue, as Dr. Goldthwait has pointed out, while the knees are characteristically relaxed, and the head active (bent forward, addressing an audience), the trunk is magnificently erect. Both the figures of Saint-Gaudens' Sherman and the Angel who leads him toward achievement and victory convey, largely through their noble bearing, the sense of inspiration. Macmonnies, in his statue of Nathan Hale, shows, through the magnificent erectness of the pose — magnificent in spite of the strain of the pinioned arms — the superiority of the spirit over death itself. When Walker wished to typify Lyric Poetry, it is inconceivable that he could have done so with a figure of imperfect carriage. The song and gladness of the human heart, its love and faith and prayer, its loftiest vision and noblest aspiration, are depicted in a figure of perfect poise, — and all of these qualities education should achieve for the children.

APPENDIX

APPENDIX

Note 1, Page 4. **IMPERFECT ADAPTATION OF THE HUMAN BODY TO THE ERECT POSITION.** — Among the pathological conditions ascribed to the imperfect adaptation of the human body to the erect position are appendicitis, hernia, gallstones, varicose veins, hæmorrhoids, torpid action in the liver and ascending colon, and various ptoses, or displacements of viscera which lead to derangement of functions. Many of the disturbances listed above are largely due to the difficulty of lifting the blood, or other moving masses, liquid or solid, against gravitation, — a difficulty that does not exist in the horizontal position, and that, in the erect position, is increased by the pressures and displacements of poor posture. Dr. Clevenger discovered that the arrangement of valves in the veins assists circulation in the quadrupedal or horizontal position, but that valves are often lacking where most needed, or, when present, sometimes hinder circulation, in the erect position. This fact and others noted in Baker's brilliant summary of points in which the body is as yet imperfectly adapted to the erect position, furnish some of the strongest arguments for good posture and exercise. As Baker says, "Adaptation to the erect position is still going on and is far from complete." Small wonder that it needs to be an object of education for every child.

Note 2, Page 9. **THE VERTICAL LINE TEST**, as here used, is a practical means of determining the large, fundamental facts of bodily poise. Such a means is essential in educational work,

where the posture of large numbers of children with clothing on has to be judged by teachers not trained in scientific technicalities of the subject. Under such circumstances even the trained expert must have some simple, effective method of determining the larger facts of posture. The vertical line test is a synthetic method which includes at a glance the entire body, as distinguished from the analytic methods in which one detail after another is considered. The vertical line as a standard of comparison for erect posture has been used before, but not, within the author's knowledge, just in the way here described for paralleling the apparent axes of the large segments and determining the distribution of the weight. Orthopedists have commonly used a vertical line for judging lateral deviations in scoliosis, wry neck, etc., and in 1902 Dr. Robert W. Lovett, of Boston, published a method of using a vertical line in observation and record of antero-posterior deviations.[1] By means of Dr. Lovett's method is measured the distance from a vertical line of certain bony landmarks; namely, the middle of the mastoid process, the spine of the vertebra prominens, the spine of the seventh dorsal vertebra, the spine of the fourth lumbar vertebra, the middle of the great trochanter, the middle of the head of the fibula, the middle of the external malleolus. This method of detailed measurement serves to indicate in some important particulars the improvement of posture from treatment, and in records accumulated through its use gives a basis for the study and classification of certain points which may help to establish their relation in normal attitudes. It is not, however, a quick, practical, working method such as a teacher might use with a class of children.

Some physical trainers have long made a different use of a

[1] Lovett, 92.

vertical line in judging the standing position, claiming that such a line should fall through certain landmarks, as ear, hip joint, ankle, etc. These landmarks, however, have varied with different instructors, being empirical in origin, and the method has the disadvantage of calling attention to many details, instead of to the larger facts of poise as a whole.

The vertical line test as used in the present work, by showing the direction of the axes of the large segments of the body, combines at once the methods of the artist and the scientist. From the scientific standpoint, the segments chosen are those indicated in poor posture, where the cervical vertebræ form a distinct axis as shown by the outlines of the neck, or even blend with the upper dorsal vertebræ; and the line or axis of the trunk below these follows the direction of the exaggerated backward slant of the lower part of the dorsal curve blending with the lumbar curve. At the same time it allows leeway for minor individual variations, and is not dogmatic on any of the technical points on which experts are not agreed, such as the degree of obliquity for the pelvis.

The apparent vertical axis of the trunk in an erect position, and the continuation of it through the cervical spine, as prescribed in the vertical line test, is easily detected by the eye. Indeed, the technical expert, even though searching for a norm by means of study and classification of various types of standing, has had to rely, meanwhile, on his own recognition of equilibrium, as detected by the eye, to know when his patients had corrected antero-posterior faults of posture. In other words, while the orthopedist and physical trainer have heretofore emphasized details of postural defects in their formulated study or instruction, they would seem in practice to use a quicker, synthetic method which at a glance gives a general estimate of the larger

diameters of the body. This is also the usual method, worked out with plumb line, by which artists have modeled and painted perfectly poised figures.

That the apparent diameters as a whole may be readily detected by the lay worker and that they form a thoroughly practicable means of determining posture, has been proved by the facility with which 5000 teachers as well as children themselves, have mastered the method. The success with which teachers have learned to judge of posture by this method is shown in the fact that, after a year's use, the judgment of the experts differs from that of the average class teacher only in from one to four cases in classes of fifty pupils, and in a very large number of classes the judgment is the same. The author has never seen such results from the use of the conventional analytic methods. Any one, then, who can teach drawing, or who has an equally accurate eye, can use this synthetic method of judging the poise of the body, thereby detecting whether or not the axes of the head and trunk be vertical, and whether or not those axes line up with the rest of the body.

It will be noticed that the term "apparent vertical axis" is used for the trunk, for anatomically the axis of the abdomen follows the line of the lower part of the dorsal curve, and the axis of the pelvic cavity joins this at right angles.[1] These unapparent anatomical details, however important for the expert, are non-essential for perception of the posture of the trunk as a whole, and when explained to the lay mind only lead to confusion, so the *apparent* vertical axis only is here referred to.

It will also be noticed that no exact point is mentioned in front of the ear, or in the forward part of the foot, where the vertical line for poising the weight should be placed. This avoidance of

[1] Goldthwait, 48; Dickinson, 31 (both after Corning).

dogmatism on detail was found necessary, as in working out this test with several hundred pupils, the author found that the position of the weight line in relation to ear and foot might vary from zero to one inch, and in a very few cases even more. Or stated differently, it was found that if the line were placed exactly in front of, and touching the ear (lobule), it would in many subjects fall through the ball of the foot, but in many others a line so near the ear would require too much of a forward inclination of the entire body if dropped to that point within the foot. This would give, not an impression of perfect uprightness, but of a falling forward. The line serves its purpose of forming a parallel to the vertical axis of trunk and neck wherever placed in relation to the ear, so its distance from the ear for determining the poise of the weight is left for individual adjustment. It is found that the teacher's sense of the general uprightness of the figure may be trusted for placing this line. Indeed, after some practice, the literal use of a tangible line becomes unnecessary.

The place where the line should fall in the foot is another point on which some slight degree of variation has to be allowed. There are differences of opinion among orthopedists as to what part of the foot should bear the main weight. It has become a tradition in physical training that the main weight should be on the balls of the feet. Drs. Lovett and Reynolds, however, place their line of gravity in the middle of the foot, measured from toe to heel (see Fig. 9), so that it falls through the arch, but other authorities place the main line of the weight anywhere from the malleolus to the metatarsal joint. There would seem no room for difference of opinion on the necessity of the weight being borne partly by both supports of the arch (heel and ball of foot), and as a mechanical principle the line of gravity should presumably fall midway between these two points. As a matter of practice,

however, there can be little doubt that a very large number of people carry the weight habitually too far backward, thus throwing out of their proper relation the thighs and pelvis, and disturbing the balance of the whole figure in a way that involves the carriage of spine, chest, and head. It therefore becomes advisable, as a teaching principle, to emphasize the forward carriage of the weight, and it was for this reason that, in adapting the vertical line test, this line was placed in front of the ear and in the forward part of the foot, instead of through the mastoid process and down into the astragulus as sometimes used in orthopedic demonstrations. By the term "forward part of the foot" is meant, therefore, any point from the middle of the arch to the ball of the foot. This leaves room for those variations in position that may be neccessary from the different placing of the center of gravity in different individuals.

The use of the vertical line test as here given had been worked out by the author and used for a year before knowing of Dr. Lovett's balance for determining the line of gravity. It is more than interesting to note the coincidence between the vertical line of the first-mentioned test and Dr. Lovett's line of gravity shown in Fig. 9. So nearly alike is the position in which they are placed that the vertical line test, besides serving its purpose of furnishing a parallel for the diameters of the large segments of the body, and the proper placing of the weight on the feet, may be said also to approximate the line of gravity.

Just what constitutes the normal erect position as regards the proper relation to each other of anatomical points, has never been definitely formulated. Physical trainers, one of whose main duties is to cultivate good posture, have had almost as many formulas for changing the relation of parts as there are instructors, the one uniform point of procedure being the atten-

tion to analytic detail. Some of the customary phrases for these details are as follows: head up, head high, head tall, chin in, neck against back of collar; chest up, chest high, chest forward, chest large, chest out; hips back, abdomen in, "stomach in," skirt tipped down in front. The term "shoulders back" is found almost exclusively among laymen; indeed, physical trainers usually bend every effort to stop its use, as the throwing backward of the trunk to which it leads is most objectionable; but, unfortunately, no other term effective for correcting the position of the shoulders seems heretofore to have been substituted. After an extended experience with nearly all the phrases mentioned, the author has discarded most of them, for the main reason that the standard of posture that resulted from their use was far from satisfactory. Apparently there was needed some more direct and fundamental way of appealing to the child's muscular control. This was found in the methods described in Chapter XIII, in which the correct position is assumed (with or without assistance) without the use of such cues or phrases, the latter (few and selected) being used when needed *after* the muscular sense of position has been aroused, and not *before*. The larger, synthetic method of recognizing posture through the vertical line test has proved vastly more effective for teachers. Further, in trying to meet the teaching problem of appealing to the child with phraseology that will lead to the right result, and not to exaggerations, it has been found that most of the conventional phrases have led to a neuromuscular action as faulty as the position they were intended to correct. The few phrases that have been found free from objection are given in the chapters on how to correct posture.

Among orthopedists there has been similar lack of formulation or agreement as to many analytic details and their relations in

good posture, such as the normal variations in the curves of the spine, tilt of the pelvis, etc. In 1902, Dr. Lovett, after a careful survey of English and foreign literature on the subject, wrote: —[1]

"The common type of faulty attitude, the one known as 'round shoulders,' has received very scant attention in American and English textbooks on orthopedic surgery. . . . In German, on the other hand, are numerous articles dealing not only with the normal attitude in standing, but with variations from the normal. But even here there is but little agreement as to what the normal attitude is."

All the more need for some large, simple, practical criterion for educational use pending the formulation of further details.

The need for considering the whole figure instead of any limited section of it, in order to arrive at correct conclusions on posture, is indicated in the following passage from the same article: —

"The difficulty with the classification of faulty attitudes seems to be that the antero-posterior outline of the spine alone has been chiefly considered and but little or no attention has been paid to the relation of the feet, legs, and pelvis to the spine, and of the whole body to the perpendicular. And, again, no uniform system of measurement has been in use. Under these conditions have been only parts of the problem formulated. The general attitude is likely to be imperfectly represented by any drawing or observation of the spine alone, because it is obvious that a backward curve of the upper part of the spine cannot occur without disturbing the normal relation of all the supporting structures below it. Equilibrium must be maintained, and the necessary adjustment involves feet, legs, and pelvis in their relation to the spine and to the perpendicular."

Note 3, Page 10. **CLASSIFICATION OF FAULTY POSTURE.** — The four types of faulty attitude here given are those into which all of the main faults of posture may be grouped. Within each of these groups are many minor variations, or combinations of elements, which various orthopedists have tried to

[1] Lovett, 92.

classify under distinctive names, but without any general agreement except that an exaggerated lumbar curve shall be called lordosis, and an exaggerated dorsal curve, kyphosis. For a review of these classifications, see Lovett, 92.

For practical teaching purposes in schools, a closer analysis or classification of faulty posture than that suggested in the present volume appears to the author superfluous, however important such work may be for scientific purposes. If the long axis of the trunk, including the neck, conform to a vertical line as here described, and if the shoulder girdle be placed in position, the various parts almost invariably fall into normal relations, and the antero-posterior deviations are automatically corrected. It therefore matters not for practical teaching purposes whether the habitual posture was a "round back," a "round hollow back," a "hollow back," or any other of the types for which names are as numerous as the possible arithmetical combinations of the elements involved.

See also Appendix, Note 11.

Note 4, Page 19. **CENTER OF GRAVITY IN THE HUMAN BODY.** — The balance of Reynolds and Lovett would seem to place the center of gravity farther forward than shown by previous investigations. They say: "Up to the time of this, our contribution to physiology, there had existed, so far as could be learned from a study of literature, no reliable method of estimating the position of the center of gravity of the body in the upright position. Various loose statements as to its location are given in literature, and there are a few carefully formulated attempts to determine it by a study of the masses of the body post mortem and their relation to each other, but scarcely any two writers agree as to what the erect normal posture should be." [1]

[1] Reynolds and Lovett, 115.

"So far as the observations by this method have gone, they show that in the erect position the center of gravity of the body lies in front of the ankle joints, which are held in dorsal flexion in this position by the gastrocnemius muscles. The center of gravity lies also in front of the knees, which are similarly held in position by the hamstring and quadriceps extensor muscles. The center of gravity lies also anterior to the sacroiliac joints and most of the vertebral joints. The position of the acetabula cannot be determined in the erect position in the living individual, because we have no means of locating them from any available landmarks. If we were able to determine the position of the acetabula in the antero-posterior plane, it would be possible to state definitely, from the relation of the center of gravity to them, whether the trunk in the erect position would tend to fall forward or backward at their level." [1]

Dr. Lovett concludes, however, from other experiments, that the trunk would fall forward but for the "combined and continued action of the posterior musculature, the chief factors here being the hamstrings, the glutei, and the erector spinæ muscles."

A summary of work on the center of gravity previous to that of Reynolds and Lovett will be found in Schäfer, *Physiology*. See also Hall, *Adolescence*, Vol. I, p. 61, and bibliography in Lovett, 86, p. 172.

Note 5, Page 33. **THE RELATION OF ABDOMEN AND THORAX IN RELAXED POSTURE.** — The author is inclined to think that unless there be abnormal outlines from sagging viscera, the protrusion of the abdomen in relaxed posture is more apparent than real, — an appearance produced by the backward sagging of the thorax. In correcting the position, and bringing forward the upper spine, there is a tightening of the abdominal muscles, but these act on the front of the pelvis as a fixed

[1] Lovett, 86.

point, and bring the thorax forward rather than draw the abdomen backward. There may also be a change in the tilt of the pelvis, but apparently not in its total antero-posterior position, for it is noticeable that when the thorax is brought into position, with the weight of the entire body poised vertically, the abdomen has not changed its relation to a fixed vertical line. This is shown in Figs. 3 and 4 by observing the relation of the front of the belt to the vertical line; it is exactly the same in both the poor and corrected positions, although the relation of the anterior wall of the thorax to the test line has undergone a decided change. For this reason, in trying to get the right relation between the upper and lower parts of the trunk, the author has stopped using with children the terms " abdomen in," or " hips back," finding that the phrase which more nearly expresses the main action involved, " chest over toes," secures with much more definiteness the actual muscular action desired.

A study of this relation of the relaxed abdomen to the lines of correct standing, under freer conditions for anatomical study than those afforded by the public elementary schools, would be desirable, especially in view of the prevalence of the custom of correcting the relation between pelvis and thorax mainly by an attempted retraction of the abdomen.

Note 6, Page 55. **CORRECT BALANCE OF THE HEAD.** — The vertical position of the neck seems to be determined by the fact that the head is supported on the odontoid process of the axis, which should be vertical to support it with the least expenditure of energy. Gray's *Anatomy* says, " The line of gravity of the head passes through the middle of the odontoid process of the axis."

Note 7, Page 65. **CHEST PROPORTIONS, OBLIQUITY OF RIBS, etc.** — Most interesting is the summary by Dr.

Woods-Hutchinson of the widening of the chest in the biological series, according to the uses of the forelimb, and the assumption of the erect position (Hutchinson, 68, 69). A condensed account of this is here quoted:—

"As all are aware, the human chest is, with one or two exceptions (the bats and the whales), almost unique in the animal kingdom, in that its transverse diameter is the longer, and this, of course, is obviously associated with the locomotive necessities of the anterior limbs in the quadrupedal and the erect positions respectively. The animal or quadrupedal chest having to be carried between the parallel-moving anterior limbs, naturally disposes its air space in the shape of a box, having as little width in its anterior part as is consonant with sufficient heart room and general vigor. Of this the familiar 'deep' chests of the hound and of the race horse are illustrations that will occur at once. It may be remarked in passing that in every order of vertebrates it is the exigencies of locomotion which seem to determine the shape of the chest. Even before lungs are present, it is 'deep' in the earlier forms, the fishes, for obvious 'yacht-shaped' reasons; rounded in most amphibians and reptiles which crawl flat-bellied, with legs (if present) wide apart; rounded in birds with their wide-apart wing attachments, although crested with a great keel which gives it an opposite appearance; 'deep' again in all quadrupeds with their parallel-moving anterior limbs, but flattening out in the fliers, like the bats, the pure swimmers, like the whales, and our own biped-climbing, upper families, the apes and man."[1]

Dr. Woods-Hutchinson suggested the "chest index" as such; that is, the application to the chest of the method of determining relative proportions that had previously been used for the cranium. Dr. Dwight had previously used a somewhat different method of stating the relation of antero-posterior chest measurement to the lateral diameter. He says, "The want of breadth

[1] Hutchinson, 69.

[in the infant chest] is very striking, while in the adult, throughout the chest below the level of the second costal cartilage, the antero-posterior diameter is to the transverse as 1 to $2\frac{1}{2}$ or as 1 to 3."[1] Dr. Sargent says: "At the age of six or seven years the diameters at the shoulders, the chest, and the hips at the trochanters are doubled. The diameters of the trunk with respect to thickness grow less rapidly. The diameter of the chest from front to back becomes doubled only toward the age of puberty, and from birth it grows only in the ratio of 1 to 2.36. The circumference of the trunk grows in almost the same proportion as the height and transverse diameters."[2]

In his study of relative proportions of the body and their significance in education, Dr. Tyler has independently arrived at the index method of estimating chest proportions. These proportions are mentioned in his work on "Growth and Education," and more in detail in lecture syllabi.

Dr. Hastings says: —

"Chest expansion depends more upon increase in lateral than in antero-posterior diameter. This fact is indicated by breadth of chest taken during mean normal respiration, but is fully demonstrated only when breadth of chest is taken during full inspiration." "Since by reason of the points of attachment of the ribs the respiratory movement is of necessity greater in the lateral plane, *the greater the obliquity of the ribs, the more pronounced the movement during respiration,* and hence the greater the chest expansion."[3]

The chest index would seem to be destined to important consideration in anthropometric work, especially in view of its relation to tuberculosis, as shown by the work of Dr. Woods-Hutchinson and collaborators.

The slope of the sternum in adults is given as from twenty to

[1] Dwight, in Piersol, *Anatomy*, 157. [2] Sargent, 122. [3] Hastings, 63.

twenty-five degrees.[1] In Fig. 39 it is thirty degrees. The slope of the sternum in children has not been studied, so far as the author has been able to trace, but it is obviously considerably less, being a factor in the rise from the sixty-three per cent depth of the flat-chested age (eleven to fifteen years) to the seventy or seventy-two per cent of adult proportions.

Note 8, Page 173. **CORSETS; HIGH HEELS.** — Drs. Reynolds and Lovett classify corsets for their effects on posture as bad and as good. The common characteristics of bad corsets they describe as follows:—

"1. They are long behind (especially at the top) and short in front (especially at the bottom). 2. They are cut to exert their greatest pressure at the waist, and at the top and bottom are capable of exerting pressure only against the wearer's back. 3. They have strongly marked sacral curves [*i.e.* outward behind over the buttocks], but are otherwise straight in the back, and are highly incurved at the waist in front." The common characteristics of the corsets classed as "good" are: "(1) that they are short behind (especially at the top), and relatively long in front (especially at the bottom); they fit the wearer tightly around the pelvis (especially in the space between the iliac crests and the trochanters) and decrease regularly in pressure to their upper edge where they are very loose (especially behind); (3) they are considerably incurved at the waistline at the back and sides, but show no waist curve in front." These points are amplified as follows: "The corset should fit very tightly in the space between the trochanters [top of the thigh bone near where it joins the pelvis] and the iliac crests [top of the hip bone or pelvis]. This anchors the corset and in many figures prevents its riding up without the use of the objectionable front garter. It should merely fit [*i.e.* set to the figure, but not tight] over the iliac crests and immediately above them, as tightness at this point is uncomfortable and makes the corset ride up. In the back it should fit the hollow of the waist snugly, being hollowed in at the back, but not at the front, and above the waist it should be left as loose as the patient will wear it. In the front it should be straight without constriction at the waist. . . ."

[1] Gerrish, 151; Morris, 156.

"The anterior bones should run from above downward and strongly forward. . . ."

"To be properly applied, a corset should be laced in three sections, sacral [the outward curve over the hips or buttocks in the back], lumbar [the hollow of the back], and dorsal [over the shoulders]. Before it is put on, all the lacings must be widely loosened. The corset must then be settled into place as low as it can be worn and clasped. The patient should then pass the hand inside it and lift the abdomen into it, settling the front of the corset as low as possible. The lumbar lacing should be pulled comfortably snug. The sacral lacing should then be made as tight as can be borne, and if the corset is so made as to spare the iliac crests, and properly cut out for the thigh in front, very tight lacing around the solid pelvis is comfortable. . . . The dorsal lacing should be left as loose as possible."

Dr. Dickinson, as the result of tests and observations extending over many years, and much original work in testing the pressure exerted by different types of corsets at different points, gives detailed directions from which the following are taken: —

"In general there should be the least possible downward pressure on internal organs; no undue tightness, and no forward carriage or droop of chin, as a result of wearing a particular corset."

"The designs to be preferred show the front straight, with little or no incurve at the waist, long below, reaching nearly to the pubic bone; back curved, low at top; separate lace for lower six or eight holes."

"Pressure should be greatest around the hips, carefully and snugly adjusted, diminishing above this zone, *being less at the waistline than below the waist. The lower ribs must have play.* With regard to posture or carriage, the shoulders must not be thrown forward and hips backward," the position being judged first by standing correctly without the corset, and then after it is put on. . . . "The above applies to the dress corset. For active work a very flexible, short, loose corset may be worn, or merely shoulder straps to support the skirt."

Dr. Dickinson advises that the first adjustment of a corset be made with the wearer lying down.

As to tightness, Dr. Dickinson considers that for adults, except in cases of special weakness, a corset that springs open two and one half or three inches when unclasped does not show an excessive pressure, if that pressure be distributed as previously explained.

It should not be inferred that any of the physicians quoted on this subject consider even the best corset harmless, or as good as entire freedom from such restrictions. Dr. Dickinson is very outspoken on this subject and does not agree with his confreres in calling any corset "good." The latter plainly state that their study relates entirely to the relation of the corset to posture and leaves out all other considerations. Dr. Dickinson finds that the type of figure or build makes a difference in the possible harmfulness of corsets. On this point he says: —

> "The muscular and active woman, with abdominal walls of good tone, and pelvic floor firm, . . . with internal organs normally anchored and no great fat padding, — this type is little harmed by corsets. The relaxed woman, long-bodied, her lower chest easily compressed, her internal organs lacking fat cushions that are adequate and supports that are resilient . . . is commonly harmed by corsets."

Dr. Dickinson's article in particular is profusely illustrated, showing, among other things, the types of permanently distorted figures that are beginning to be seen in art, for which corset deformed models have posed. When the author of the present work spoke of the use of such models to an official of a prominent art school, asking why such models were used, misleading pupils as to the correct lines of the figure, the answer was, "But it is almost impossible to get models of unspoiled figures." [1]

[1] See Dickinson, 31; Reynolds and Lovett, 115; Mosher, 102; Galbraith, 44.

Drs. Reynolds and Lovett found that high heels tend to restore the equilibrium lost through corsets that throw the figure out of true. Such heels lead to an unnatural straightening backward of the body to offset their primary tendency to tip it forward. Whatever the effect on equilibrium may be, the lack of freedom and grace of movement is obvious. There is also an unavoidable strain on ligaments throughout the body.

Note 9, Page 188. **MOTIVATION OF PUPIL'S WORK.** — Teachers will appreciate the significance and power of motivation of children's work, and the difference between motives and incentives. In his "Report on the Motivation of the Children's Work in the Elementary Schools," Mr. H. B. Wilson, Superintendent of Schools in Decatur, Ill., says: —

"The largest problem in the technique of teaching is that of supplying adequate motives for the work of pupils. The psychological rather than the logical organization and presentation of the school curriculum contributes to the motivation of school work. The pupils' needs and interests are the natural and safe avenues through which to lead them into that response to the best social standards and into those abilities which are essential to effective social participation. School work is meaningful and significant to pupils to the extent that it contributes to the satisfaction of needs, immediate or remote, that are real to them.

"An incentive is characteristically something to be had following a series of efforts, but the thing gained is not produced by, or developed through, the effort expended. Rather, the thing gained is external to, or outside of, the immediate result produced by the effort. Incentives range, to be sure, from the most material, mercenary prize to the loftiest social and spiritual gift, or reward, man can confer. The effect of an incentive is to move the mind, stir the passions, and cause action. It is, however, as noted above, external to the direct results produced by the acts it excites. It stimulates one to efforts, much as martial music quickens the step and strengthens the courage of the soldier, inspiring him to do his duty, even in the face of grave danger. . . .

"A motive is not an external reward conferred at the conclusion of a series of efforts; . . . The distinctive mark of genuine motive is that the contemplated end is produced by, and realized as, the results of a series of efforts. . . .

"My experience as a boy on the farm definitely illustrates the operation of a genuine motive. For the work I did in gathering and marketing the butter and eggs, I shared the profits derived from the production and sale of this produce. This profit was the 'gratification contemplated'; it was my goal. It caused my effort, and this effort produced the contemplated end (the profit) which served to motivate my acts. Whether one's motive be to earn money, write a letter, assist his classmates, or delight his parents, it operates similarly, generating the effort which, if successful, enables him to realize the longed-for end. . . .

"It is evident, perhaps, that whereas incentives are superficial and external in relation to one's efforts, motives are fundamental and vital in determining effort; one is held before the child to stimulate him, while the other arises out of his own efforts in self-expression and self-realization. Any motive operates as an incentive, but no mere incentive constitutes a genuine motive." — *Proceedings National Educational Association*, 1911.

A previous report and discussion of this subject will be found in the N.E.A. Proceedings for 1910.

Note 10, Page 214. **THE MUSCULAR SENSE.** — By the muscular sense is here meant a sense of the position of the body or any of its parts, or of the force or amount of muscular contraction necessary for any position or movement.

"It is somewhat difficult to present a precise definition of the term 'muscular sense.' Authorities have not been perfectly concordant in their use of the term. It may perhaps best be taken to include *all reactions on sense arising in motor organs and their accessories*."[1] For instance, if the reader will shut his

[1] Schafer and Sherrington. See also Münsterberg, Halleck, and other psychologists.

eyes, he can say without looking at his own body, whether or not he is sitting in an erect or slouching position, or whether his right foot is forward of his left, or *vice versa*. This knowledge is conveyed by the muscular sense. Similarly, it is the muscular sense that enables him to know how much to contract certain muscles to correct his position, just as it is the muscular sense that enables a baseball pitcher to determine the force and coöperation (coördination) of muscular action necessary to throw a ball a certain distance in a certain direction to the catcher.

However instinctive may be the infant's striving for an upright position, the gradual achievement of that position from the baby who cannot hold up its own head to the little child who stands and walks alone, implies a training, not only of the muscles, but of a sense of their coördination, and the subconscious sense of equilibrium.

"The muscular sense is no doubt a large contributor toward the perception of the mechanical equilibrium of the body, and in that way toward the regulation and maintenance of its stability. The necessary corrective movements that, during locomotion, prevent gravity pulling us prone, or, as we sit, stand, or maintain postures natural to us, involves perception of the relative position of our corporeal parts, are guided by — one might almost say supplied by — the muscular sense. These perceptions, though not for the most part 'objects' of attention, determine actions, and can be attended to at once, should they arise." [1]

Note 11, Page 221. **OVERCORRECTED POSTURE.**—That exaggerated posture of the "bantam" type is not a correct standing position would scarcely seem to need argument. The fundamental requisite of a correct standing position on which all authorities are agreed, is that the different parts of the body shall be so placed in relation to each other as to require a mini-

[1] Schafer, 159.

mum of muscular effort or strain. The exaggerated lifting of the sternum, distention of the ribs, and hyper-extention of the spine called for by this exaggerated attitude can only be brought about by extreme muscular tension, which cannot be long sustained.

To cultivate lordosis through an exaggerated standing position, is to cultivate it as an habitual feature when the temporary effort of the overcorrected position is relaxed. This is plainly shown in the aggravated points of the relaxed fatigue position which is the alternative posture of pupils trained for the exaggerated standing position. If the spine alone were involved, the fault might not be so serious; but the mechanical reactions of the body are such that when one part is thus displaced, other parts change their positions also to maintain the equilibrium. As Dr. Lovett says, "An increase of the backward curve of the spine implies a forward curve or forward displacement somewhere else to balance it."

The harm wrought by the lordosis position is comprehensively stated by Dr. Goldthwait in the following excerpt describing the type of lordosis caused by displacement backward of the upper part of the trunk (dorsal spine): —

"In this change the pelvis maintains its normal position and relation to the legs, but as the upper part of the lumbar spine moves backward, as it must in the position of lordosis, the depressions into which the posterior viscera rest are consequently deepened, and as far as this feature alone is concerned there is less liability of the organs becoming displaced downward than is normal. Since, however, this feature is only one part of the support of the viscera, and since the anterior abdominal wall is of much importance in this support, it is evident that as this position necessarily means relaxation of the abdominal muscles, a definite portion of the normal support is lost.

"It is also evident that as in this position the abdominal cavity as well as the entire length of the trunk is shortened, the viscera are

necessarily crowded downward. In this shortening of the trunk the antero-posterior diameter of the abdomen is necessarily increased, and with this increase of the diameter the diaphragm must be stretched antero-posteriorly, with the result that it becomes flatter and the upper part of the dome is lowered. Since at the back the diaphragmatic attachment extends down to the last rib, and since the liver rests directly against this posterior portion of the diaphragm, if the dome of the diaphragm is flattened, it must result in forcing the liver and stomach forward and downward, lifting them out of their normal positions in the spaces at the sides of the spine in the curve of the ribs. This naturally results in an increased pressure upon the kidneys and other viscera, with varying degrees of disturbance.

"With the kidneys the pressure must naturally result in the gradual absorption of the retroperitioneal fat upon which they rest, with a weakening of this natural support so that even though the depression in which the organs rest is deepened, the fat tissue may be so much absorbed that together with the lack of tone of the abdominal muscles an undue mobility may result." [1]

The objections to purposely cultivating, as a fundamental standing or gymnastic position, an exaggerated posture, with its hyper-extension of the spine and artificial protrusion of the chest, cannot be too strongly stated. It has already been pointed out that this overcorrection cultivates lordosis, interferes with respiration, and tends, in children, to arrest development of the chest. The policy of using such a position for corrective purposes, therefore, not only fails of its object, but works positive injury. In a somewhat extensive correspondence with leading orthopedic surgeons in this country, the author has yet to find one who does not condemn this exaggerated position. Indeed, many of these practitioners have special methods for avoiding any tendency to overcorrection in the execution of exercises prescribed for their patients.

[1] Goldthwait, 48.

From a pedagogical standpoint, encouragement of such positions is indefensible. The training of the muscular feeling, or muscular sense, of what is right, is one of the great fundamental educational elements in this whole question of training correct posture; indeed, it is probably the most important point in the entire question. The erect position for a child should always be the correct position, no matter for what purpose it is taken. To allow him to assume an exaggerated posture for his gymnastic lesson on the assumption that, by overdoing it then, he will relax into the proper position ordinarily, is worse than a pedagogical absurdity, — it is a positive injury to the child. One might just as well allow him to overshoot the mark in his arithmetic lesson and say that twelve times five are sixty-five, on the assumption that he will drop back to the right figures of his own volition in after life. In establishing the power and habit of good posture with the many thousands of children trained by the efficiency methods described in this volume, the principle of training the child to discriminate between correct and exaggerated posture has been sedulously followed. When a parent has said, "My boy comes home and says he is being taught to stand *this* way," illustrating a ridiculously overdone position, the school in which the faulty teaching occurred has been visited and the teacher found whose discrimination on these points needed more assistance. In a few instances a whole school, through the mistake of a local supervisory official, has been characterized by some marked exaggeration in the standing position of the children; this has been made a matter of thorough and repeated assistance as soon as discovered.

There can be no doubt that overcorrection is the easiest way of appearing (to the uninitiated) to correct the faults of relaxed

posture. It often requires less effort on the teacher's part to get overcorrection than accurate positions in the children; but accurate teaching is at least as important in physical training as in other subjects. It is impossible to avoid all overcorrection in the first efforts of children to remedy their defects of posture; this is true especially of the youngest children, who lack power of muscular adjustment. But such faults should be attacked as promptly as any others, and the ideal held before both children and teachers should be, always, the correct, and not artificial, positions.

Note 12. **HISTORY AND BIBLIOGRAPHY.** — The subject of posture has been studied from many viewpoints in science, art, and education: by the anthropologist, tracing lines of evolutionary development; by the physicist, seeking to place the center of gravity of, and to apply the laws of mechanics to, the human body; by the artist, posing figures for modeling and drawing; by the nerve specialist studying indications of nervous states; by the physical trainer trying to develop to the full the physical powers; by the psychologist and actor observing the expression of the emotions; and by the medical practitioner, searching for etiological factors in disease.

The most valuable scientific contributions to the subject have been made within comparatively few years. The displacement of organs, or ptosis, has, perhaps, led to the widest interest and study of the subject. In this country Dr. J. H. Kellogg, of Battle Creek, Mich., first presented the subject widely to the medical profession, to popular audiences, and to educators. Writing in 1896, Dr. Kellogg said: —

"My own attention was called to the importance of the relation of these displacements to the general health by the writings of Glénard and Pasteur, two eminent French physicians who, twelve or

fourteen years ago, began to address the profession on this subject. Glénard pointed out that with the great majority of persons suffering from chronic indigestion, prolapse of the stomach or bowels, or both, is the fundamental cause of the disease, and showed that many dyspeptics may be cured by the simple application of a bandage for the support of the prolapsed organs."

In 1892 Dr. Eliza M. Mosher, of Brooklyn, presented to the medical profession and to educators, studies in the effects of posture that attracted wide notice. Dr. Robert W. Lovett has placed all students of posture in his debt for the wide scholarship and scientific value of his contributions on many phases of the subject, made both independently and in collaboration. The development of X-ray photography has made possible a distinct line of research on the subject of ptosis, — research in which Dr. Joel E. Goldthwait and colleagues of Boston have done signal work. Dr. Goldthwait's contributions to this and other phases of the scientific study of posture are of the highest value. They have been presented both in technical and popular form, have attracted wide attention, and have given new impetus to the subject. From many other sources contributions have been made to the studies of the ptoses, their cause and effects. Many of these contributions are listed in the Bibliography given in the present volume. A very valuable summary of the investigations, theories, and conclusions of more than a dozen other workers — including Stiller, Cseri, Glénard, Faure, Landau, Brault, Linder, Kuttner, Laider, Schwerdt, Brühl, Hagem, Lion, Hertz, Voeglsang, Bovier — has been made by Dr. Cumston (see Bibliography, 26).

Parallel with the study of the subject from the viewpoint just mentioned, has been the research of orthopedists. Antero-posterior deviations of posture have been studied in Germany,

chiefly by Langer and Meyer, Stäffel, Henke and Boegle, who have sought to establish types of variability and to determine a norm for the erect position.

The work of these and other men, German, French, and Italian, is cited in Lovett, 92, and 86, p. 172.

In earlier studies of the subject, the spine was the main object of attention, but all of the later workers realize that the entire body must be considered in any correction of posture. This is especially emphasized by Drs. Lovett, Goldthwait, Mosher, (E. M.), and Taylor (H. L.).

The names of certain workers are associated, though by no means exclusively, with studies of different parts of the body in relation to posture. Thus, we look to Lovett particularly for helpful work on the spine; to Mosher for the pelvis; Fitz and Goldthwait for the shoulders; Woods-Hutchinson for the chest. The foot has been studied by many, though Dr. Henry Ling Taylor probably first gave prominence to the importance of the straight-foot position. On all phases of posture very valuable contributions have been made by others than those named.

The technical student will find the applied anatomy of posture treated in the works of Lovett (86), Goldthwait (47, 48, 49, 51, 52), Skarstrom (161), and Bowen (145); medical gymnastics in Lovett (86), Taylor (133), McKenzie (98), and Martin (97). While the subject of posture is not treated of in Dr. Tyler's work on "Growth and Education," no student of child development could omit knowledge of that work or of Dr. G. Stanley Hall's classic volume on "Adolescence."

The upholding of standards of posture has been a prominent object in the work of physical trainers; and the recognition, by educators, of the need for work in this direction has probably had

more to do with the introduction of physical training into school curricula than has appreciation of any other benefit from exercise.

In the bibliography appended to this volume, no attempt is made to give complete references on such related topics as scoliosis, flat foot, or other orthopedic defects, on the general growth of children, on school furniture, or on school or personal hygiene. On these topics only the more important references are given, or those that contain comprehensive summaries, or that have a direct bearing on antero-posterior aspects of posture.

The student of efficiency methods will find especially helpful the two books by Mr. Harrington Emerson, *Efficiency* (164) and *The Twelve Principles of Efficiency* (165), and Mr. Taylor's *Principles of Scientific Management* (169). These works are not only rich with practical help, but their wealth of illustration and breadth of vision make them most fascinating reading, while their strong humanitarian spirit is an uplift and inspiration.

BIBLIOGRAPHY

I

BIBLIOGRAPHY ON POSTURE, AND RELATED TOPICS[1]

1. ABBOTT, GLADYS, *A Study of Posture in School as Affected by Schoolroom Lighting.* Am. Phys. Ed. Rev., March, 1905. An effective study of facts in the schoolroom.
2. ALLIS, OSCAR H., *Man's Aptitude for Labor in the Erect Position.* Trans. Col. Phys., Phil., 1887, 3d ser., Vol. IX, p. 35. The center of gravity and its method of support in fish, bird, quadruped, and man. Mechanics of, and anatomical adaptations to, the erect position and to rotary motion in that position. A most valuable presentation of the subject, with ingenious original diagrammatic illustrations.
3. BAKER, FRANK, *The Ascent of Man.* Vice-Presidential Address, Section on Anthropology, Am. Ass. Adv. of Sci., 1890. The most valuable summary of the anatomical and physiological disadvantages of erect posture, showing that man's adaptation to this position is not yet complete and is still going on.
4. BANCROFT, JESSIE H., *Automatism in Gymnastic Exercise.* Am. Phys. Ed. Rev., December, 1903.
5. BARBAT, J. H., *General Enteroptosis.* Calif. State Jour. Med., 1906, Vol. IX, p. 291.
6. BENEDICT, A. L., *Clothing, A Hygienic Heresy.* Med. Times, N. Y., 1908, Vol. XXXV, p. 361.
7. BLAKE, JOSEPH A., *What are the End Results of Surgery or Surgical Operations for the Relief of Neurasthenic Conditions Associated with the Various Visceral Ptoses.* Surg., Gynec., and Obstet., 1910, Vol. XI, pp. 59–63.
8. Boston Schoolhouse Commission. Reports on *School Furniture,* 1901–1905. Among the latest and most important studies of the subject. See No. 25 of this Bibliography.
9. BRADFORD, E. H., *The Effect of Recumbency on the Length of the Spine.* Boston Med. and Surg. Jour., Vol. CIX, p. 245, September, 1883.
10. BRADFORD, E. H., *Movement of the Front of the Foot in Walking.* Jour. of the Boston Soc. of Med. Sci., Vol. III, 7, p. 205.
11. BRADFORD, E. H., *Round Shoulders.* Trans. Am. Orth. Ass., Vol. X, p. 162.

[1] See Appendix, Note 12.

12. Bradford, E. H., *Flexion, or Bent-Knee Marching.* N. Y. Med. Jour., Jan. 27, 1900, p. 109.
13. Bradford (E. H.) and Lovett (R. W.), *A Treatise on Orthopedic Surgery.* Wm. Wood & Co., N. Y., 1890. Round shoulders, lateral curvature, flat foot, etc.
14. Bullard (W. M.) and Brackett (E. G.), *Observations on the Steadiness of the Hand and on Static Equilibrium.* Boston Med. and Surg. Jour., Vol. II, 1888.
15. Burke, Frederick, *Growth of Children in Height and Weight.* Am. Jour. of Psych., April, 1898. One of the most valuable summaries of data on growth of children; large bibliography.
16. Cabot, Richard C., *Physical Diagnosis.* Wm. Wood & Co., N. Y., 1905. Points on chest, spine, and shoulder development.
17. Chaille, S. E., *Infants: Their Chronological Progress.* New Orleans Med. and Surg. Jour., Vol. XIV, 1886–1887, p. 893.
18. Chamberlain, Alex. F., *The Child: A Study in the Evolution of Man.* Scott, Lond.; Scribner, N. Y., 1900. Erect posture; growth.
19. Clark, John G., *The Surgical Consideration of Congenital and Developmental Defects Leading to Obstinate Constipation.* Jour. Am. Med. Ass., 1910, Vol. LV., August 6, p. 449. Discusses relation of posture to enteroptosis.
20. Clevenger, S. V., *Disadvantages of the Upright Position.* The American Naturalist, Vol. XVIII, January, 1884, No. 1. Original study of valves in the veins in their relation to the upright posture in mankind. Pathological conditions resulting from their poor adaptation to that position. Changes in pelvis and in neck of femur, due to upright position.
21. Clevenger, S. V., Editorial discussion of Dr. Clevenger's article (20), Journal of Science, Lond., Vol. VI, 3d ser., March, 1884.
22. Codman, E. A., *Chronic Obstruction of the Duodenum by the Root of the Mesentery.* Boston Med. and Surg. Jour., April 16, 1908, p. 503. Duodenum originally designed for horizontal position, and is disadvantageously placed in vertical position.
23. Cook, Ansel G., *The Question of Balance. An Elementary Study of the Balance of the Human Body and the Relation of the Balance of Shoes, including Rules for Designing or for Judging the Efficiency of Shoes.* Am. Jour. Orth. Surg., July, 1907; May, 1909.
24. Cotton, Alfred Cleveland, *The Medical Diseases of Infancy and Childhood, with Points on the Anatomy, Physiology, and Hygiene Peculiar to the Developing Period.* J. B. Lippincott Co., Phil. and Lond., 1906.
25. Cotton, Frederick J., *School Furniture for Boston Schools.* Am.

Phys. Ed. Rev., December, 1904. This gives in substance Dr. Cotton's contributions to the reports of the Boston Schoolhouse Commission (see this Bibliog., No. 8), including a valuable digest of previous investigations in this country and abroad, and the results of his own work, especially on the seat-back.

26. CUMSTON, CHARLES GREENE, *Ptosis of the Abdominal Viscera Surgically Considered.* Medical Record, Oct. 19, 1907, p. 639. General review and history of modern work on the subject of ptoses.

27. DANE, JOHN, *Some Effects upon the Leg of Pronation of the Foot.* Trans. Am. Orth. Ass., Vol. X.

28. DARWIN, CHARLES, *Expression of the Emotions in Man and Animals.* Appleton, 1880.

29. DAVIS, EDWARD P., *Mother and Child.* Lippincott, Phil., 1911.

30. DICKINSON, ROBERT L., *The Corset: Questions of Pressure and Displacement.* N. Y. Med. Jour., Nov. 5, 1887.

31. DICKINSON, ROBERT L., *Toleration of the Corset: Prescribing where One cannot Proscribe.* Am. Jour. of Obstet. and Dis. of Women and Ch., Vol. LXIII, No. 6, 1911. An original study, elaborately illustrated. Explains simple apparatus, and method for testing pressure of corset at different points. Gives bibliography on the corset from 1908 to date.

32. DONALDSON, H. H., *The Growth of the Brain.* Walter Scott, Lond.; Scribner, N. Y., 1895. Proportionate growth of body and viscera.

33. DUNLOP, JOHN, *Relaxation of the Sacro-iliac Synchondroses.* N. Y. Med. Jour., Dec. 8, 1906.

34. DUNLOP, JOHN, *Further Studies of the Relaxation of the Sacro-iliac Synchondroses.* Am. Jour. Orth. Surg., July, 1907.

35. ELLIS, HAVELOCK, *Man and Woman.* Scott, Lond.; Scribner, N. Y., 1904. Erect posture. Growth and proportions.

36. EVANS (W. A.) and MCHUGH (M. G.), *The Shape of the Chest in Some Thoracic Conditions, and Especially in Tuberculosis.* Medical Examiner and Practitioner, October, 1902.

37. FEISS, HENRY O., *The Mechanics of Lateral Curvature.* First Paper: "The Mechanical Tendencies of Posture in the Normal." Am. Jour. Orth. Surg., Vol. IV, pp. 1–37, July, 1906; other papers, April, 1907; October, 1907; January, 1908. An elaborate and valuable contribution to the subject. Illustrated.

38. FITTEROLF (GEORGE) and GITTINGS (J. CLAXTON), *Some Anatomical Features of the Child's Thorax and their Practical Application in Physical Diagnosis.* Am. Jour. of Dis. of Ch., Vol. I, 1911.

39. FITZ, GEORGE WELLS, *Bed Posture as an Etiological Factor in Spinal Curvature.* Trans. Am. Orth. Ass., 1898. Rêport of original study. Illustrated.

40. Fitz, George Wells, *A Clinical and Anatomical Study of Resistant Forward Shoulders*. Boston Med. and Surg. Jour., April 19, 1906. A very valuable original study.

41. Forbes, A. MacKenzie, *Internal and External Atony*. Am. Phys. Ed. Rev., June, 1912.

42. Fothergill, J. Milner, *The Diseases of Sedentary and Advanced Life*. London: Balliere, Tindall and Cox, 1885. Chest development as a factor in lung development. Recommends swings for children for effect on lungs.

43. Fothergill, W. E., *Some Remarks on Corsets*. Med. Press and Circ., July 8, 1903. Favors right kind of corset if not worn tight.

44. Galbraith, Anna M., *Personal Hygiene and Physical Training for Women*. Saunders, Pub., Phil. and Lond., 1911.

45. Gibney, Virgil P., Contribution in Vol. II of *System of Surgery*. Edited by Dennis, F. T.; Lea Bros. & Co., Phil., 1905. Flat foot, lateral curvature, etc.

46. Gihon, A. L., *Physical Measurements*, in Wood's *Reference Hand Book of the Medical Sciences*, Vol. V, pp. 667–673.

47. Goldthwait, Joel E., *The Importance of the Pelvic Joints in the Maintenance of the Correct Poise of the Body*. Am. Phys. Ed. Rev., June, 1909.

48. Goldthwait, Joel E., *The Relation of Posture to Human Efficiency and the Influence of Poise upon the Support and Function of the Viscera*. Boston Med. and Surg. Jour., Dec. 9, 1909. Indispensable to the technical worker and adapted also to popular reading.

49. Goldthwait (Joel E.) and Brown (Lloyd T.), *The Cause of Gastroptosis and Enteroptosis, with their Possible Importance as a Causative Factor in the Rheumatoid Diseases*. Boston Med. and Surg. Jour., Vol. CLXII, No. 21, pp. 695–703, May 26, 1910. Of great importance for the technical worker.

50. Goldthwait (Joel E.) and Brown (Lloyd T.), *The Recognition of Congenital Visceral Ptosis in the Treatment of the Badly Poised and Poorly Nourished Child*. Am. Jour. Orth. Surg., November, 1911.

51. Goldthwait, Joel E., *An Anatomic and Mechanical Study of the Shoulder-joint, Explaining many of the Cases of Painful Shoulder, many of the Recurrent Dislocations, and many of the cases of Brachial Neuralgias or Neuritis*. Am. Jour. Orth. Surg., May, 1909. One of the most important studies of the shoulder.

52. Goldthwait (J. E.) and Osgood (R. B.), *A Consideration of the Pelvic Articulations from an Anatomical, Pathological, and Clinical Standpoint*. Boston Med. and Surg. Jour., June and July, 1905, p. 593.

53. Goldthwait, Joel E., *A Consideration of the Round or Stoop-Shoulder Deformity*. Am. Jour. Orth. Surg., April, 1908.

54. GOLDTHWAIT, JOEL E., *A Consideration of the "Round Shoulder" or "Stoop Shoulder" Deformity in Childhood, with Especial Reference to the Proper Adjustment of the Clothing in Preventing and Treating Such Conditions.* Am. Jour. Orth. Surg., Vol. I, p. 64, 1903–1904.
55. HALL, G. STANLEY, *Adolescence.* Appleton, 1911.
56. HALL, G. STANLEY, *Youth: its Education, Regimen, and Hygiene.* Appleton, 1907. A condensation of the larger work on *Adolescence.* Assumption and significance of erect posture.
57. HALL, WINFIELD S., *The Changes in the Proportions of the Human Body during the Period of Growth.* Jour. Anthrop. Inst. of Great Britain and Ireland, 1895–1896, Vol. XXV.
58. HALLECK, REUBEN POST, *Education of the Central Nervous System.* Macmillan, N. Y., 1899.
59. HALLECK, REUBEN POST, *Psychology and Psychic Culture.* Macmillan, N. Y., 1900. Emotional expression and inhibition.
60. HARE, SAMUEL, *Facts and Observations on the Physical Education of Children, especially as Regards the Prevention of Spinal and Other Deformities.* J. Churchill, Lond., 1852.
61. HARTWELL, EDWARD MUSSEY. *School Furniture.* Report of the Director of Physical Training, Boston. School Document, Nov. 4, 1895. A very valuable study of the subject, giving digest of foreign and other investigations.
62. HARVEY, F. W., *Gymnastic Treatment of Diastasis of the Recti abdominales.* Am. Phys. Ed. Rev., June, 1912.
63. HASTINGS, WM. W., *A Manual of Physical Measurements,* 1902. Bassett and Co., Springfield, Mass. Measurements at different ages.
64. HERZ, M., *Interference with Heart Action by Stooping.* Theropie der Gegenwart, June, 1908, No. 6, p. 241.
65. HOAG, ERNEST BRYANT, *The Health Index of Children.* Whitaker and Ray-Wiggin Co., San Francisco, 1910. A chapter on general hygiene of erect posture and one on the foot.
66. HOLT, L. EMMETT, *The Diseases of Infancy and Childhood.* Appleton, N. Y., 1911. Relative chest circumference at different ages. Changes in chest proportions with growth. Ontogenetic acquirement of erect position.
67. HUTCHINSON, JONATHAN, *The Thorax.* Article in Todd's Cyclopedia of Anatomy and Physiology. Longmans, Lond., 1859.
68. HUTCHINSON, WOODS-, *Some Deformities of the Chest in the Light of its Ancestry and Growth.* Jour. Am. Med. Ass., September, 1897. All of Dr. Woods-Hutchinson's articles are indispensable to the technical student of posture.
69. HUTCHINSON, WOODS-, *Is the Consumptive Chest Flat?* Jour. Am. Med. Ass., May 2, 1903, p. 1196. A very important article.

70. HUTCHINSON, WOODS-, *The Form of the Chest in Phthisis and its Significance.* British Med. Jour., Oct. 28, 1899.

71. HUTCHINSON, WOODS-, *Studies in Human and Comparative Pathology.* H. J. Glaisher, Lond., 1901.

72. HUTCHINSON, WOODS-, *Foot Faults.* Good Housekeeping, July, August, 1912. Two popular and very interesting articles on the foot, its use and hygiene.

73. JACKSON, J., *Handwriting in Relation to Hygiene.* Seventh Int. Cong. Hyg. and Dem., Lond., 1891, Vol. 4.

74. JAEGER, GUSTAV, *Problems of Nature.* Williams and Norgate, London, 1897. Biological development of the human foot. Effect on infant's foot of learning to stand and walk. Biological explanation of upright posture. Growth of certain bones produced by increased use and exercise due to erect posture. Relative length of legs and trunk; the part supporting grows relatively faster than the part supported. Relation of size of vertebræ to weight bearing and to exercise of the arms. Changes during growth in chest proportions and position of scapulæ due to erect posture.

75. JAMES, WILLIAM, *Psychology.* Henry Holt and Co. Relation of emotions to posture.

76. JOHNSON, GEORGE E., *Psychology and Pedagogy of Feeble-Minded Children.* Ped. Sem., October, 1895.

77. KELLOGG, J. H., *Experimental Researches: Relation of Dress to Pelvic Diseases of Women.* Tr. Mich. State Med. Soc., 1888.

78. KELLOGG, J. H., *Outline Views of the Human Figure.* Battle Creek, 1898.

79. KELLOGG, J. H., *The Influence of Dress in Producing the Physical Decadence of American Women.* Jour. Mich. State Med. Soc., 1891.

80. KELLOGG, J. H., *The Relation of Static Disturbances of the Abdominal Viscera to Displacement of the Pelvic Organs.* Proc. Internat. Congress, Gynec. and Obstet., 1892.

81. KELLOGG, J. H., *Physical Deterioration Resulting from School Life.* N. E. A. Report, 1896, p. 899. A very helpful and important article for both popular and technical readers.

82. LAGRANGE, FERNAND, *Physiology of Bodily Exercise.* Appleton, 1890. Exercise and respiration. Automatism in exercise.

83. LANE, W. ARBUTHNOT, *Some of the Laws which Influence the Growth of Children.* Trans. Seventh Int. Cong. Hyg. and Dem., Lond., 1891, Vol. IV, p. 103.

84. LANE, W. ARBUTHNOT, *Civilization in Relation to the Abdominal Viscera, with Remarks on the Corset.* Lancet, Lond., Nov. 13, 1909, pp. 1416–1418.

85. Lister, Sir J., *An Address on the Influence of Position upon Local Circulation.* British Med. Jour., London, 1879.
86. Lovett, R. W., *Lateral Curvature of the Spine and Round Shoulders.* P. Blakiston's Son & Co., 1012 Walnut St., Phil. 2d ed., 1912. Indispensable to the technical worker. One of the classics on the subject.
87. Lovett (R. W.) and Reynolds (E.), *Method of Determining the Position of the Center of Gravity in its Relation to Certain Bony Landmarks in the Erect Position.* Am. Jour. of Physiol., May 1, 1909.
88. Lovett, R. W., *The Treatment of Round Shoulders by Forcible Correction.* Am. Jour. Orth. Surg., Vol. II, p. 200.
89. Lovett, Davis, and Montgomery, *Arch. di Ortopedia*, 1906, Vols. V and VI, p. 372. Study of curves at different ages.
90. Lovett, R. W. See also Bradford and Reynolds.
91. Lovett, Robert W., *The Mechanism of the Normal Spine and its Relation to Scoliosis.* Boston Med. and Surg. Jour., Sept. 28, 1905, pp. 349–358, June 4, 1900; Oct. 31, 1901, March 17, 1904; and in Am. Jour. of Anat., Vol. II, pp. 4, 457.
92. Lovett, Robert W., *Round Shoulders and Faulty Attitude.* Boston Med. and Surg. Jour., Nov. 6, 1902. Reprinted in Am. Phys. Ed. Rev., December, 1902.
93. Lovett, R. W. *Discussion of Pronation of Foot in Standing Position and its Association with Faulty Attitude.* Trans. Am. Orth. Ass., Vol. X.
94. Manaceine, Marie de, *Sleep; its Physiology, Pathology, Hygiene, and Psychology.* Walter Scott, London; Scribner, N. Y., 1897. Sleeping positions, etc.
95. Marey, E. J., *Animal Mechanism.* A Treatise on Terrestrial and Aerial Locomotion. Appleton; Int. Sc. Ser.
96. Martin, Franklin H., *Visceral Prolapse.* Surg., Gynec., and Obstet., December, 1908.
97. Martin, Franklin H., *Gymnastic and other Mechanical Means in the Treatment of Visceral Prolapse and its Complications.* Surg., Gynec., and Obstet., August, 1912. Of especial value to the medical gymnast. Illustrated.
98. McKenzie, R. Tait, *Exercise in Education and Medicine.* W. B. Saunders Co., Phil., 1911. Exercises for lateral curvature and flat foot. Anatomy of movements of spine.
99. Mosher, Eliza M., *The Influence of Habitual Posture on the Symmetry and Health of the Body.* Brooklyn, Med. Jour., July, 1892. An original study. Discussion by several physicians including Dr. W. F. Dudley, who spoke of asymmetrical posture as a probable cause of obstructed

nasal breathing and other defects of function and structure in nose and throat.

100. MOSHER, ELIZA M., *Habitual Postures of School Children.* Educational Review, November, 1892.

101. MOSHER, ELIZA M., *Habits of Posture a Cause of Deformity and Displacement.* N. Y. Jour. of Gynec. and Obstet., November, 1893.

102. MOSHER, ELIZA M., *Health and Happiness; a Message for Girls.* Funk & Wagnalls, N. Y., 1912. An important book in which hygiene for girls is based on correct posture. Sex education.

103. MUMFORD, A. A., *Survival Movements of Human Infancy.* Brain, Vol. XX, p. 290.

104. MUNRO, *Prehistoric Problems.* Chapter II, "On the Influence of the Erect Position." Presidential address in Anthropology at Brit. Ass. at Nottingham, 1893.

105. MUYBRIDGE, E., *The Human Figure in Motion.* Chapman Hall, Lond.

106. OCHSNER, EDWARD H., *Potential and Acquired Static Flat Foot.* Jour. Am. Med. Ass., Nov. 23, 1907. Observation on causes of flat foot, its hygiene, etc.

107. O'FOLLOWELL, *Le Corset.* 2 vols. Maloine, Paris, 1908. Elaborately illustrated; gives full bibliography to date.

108. OPPENHEIM, NATHAN, *The Development of the Child.* Macmillan, 1902. Facts in comparative development.

109. OSBORNE, JONATHAN, *On Some Actions Performed by Voluntary Muscles which by Habit become Involuntary.* Dublin Quar. Jour. Med. Sci., 1859, Vol. XXVIII, p. 120. Orignial study of sleeping positions. Comments on erect position.

110. PETTIGREW, J. B., *Animal Locomotion; or Walking, Swimming, and Flying.* Appleton, Int. Sci. Ser.

111. POLK, W. M., *The End Results of Surgical Operations for the Relief of Neurasthenia Associated with the Various Visceral Ptoses.* Surg., Gynec., and Obstet., 1910, XI, pp. 476–479.

112. PYLE, WALTER L., *A Manual of Personal Hygiene.* W. B. Saunders Co., Phil. and Lond., 1912. Chapter on erect posture by Goldthwait. Hygiene of the foot.

113. RANKIN, F. H., *Hygiene of Childhood.* D. Appleton & Co., N. Y., 1890.

114. REYNOLDS, EDWARD, *The Etiology of the Ptoses and their Relation to Neurasthenia.* Jour. Am. Med. Ass., 1910, Vol. LV, pp. 1943–1949. An important article for the technical student.

115. REYNOLDS (EDWARD) and LOVETT (ROBERT W.), *An Experimental Study of Certain Phases of Chronic Backache. A Combined Gynecologic*

and Orthopedic Investigation. Illustrated. Jour. Am. Med. Ass., March 26, 1910. Posture in relation to corsets and high heels. Good and bad corsets. Balance for determining center of gravity.

116. RIBOT, TH., *The Psychology of the Emotions.* Scribner, 1906.
117. ROSS, JAMES, *Diseases of the Nervous System.* Wm. Wood & Co., N. Y., 1883. Function of cerebro- and cerebello-spinal systems in erect posture, walking, etc.
118. ROTCH, T. M., *Pediatrics.* Lippincott, Phil., 1903. Surface anatomy of spine. Natural development of antero-posterior curves Proportionate length of above at different ages from Rasenal, Aeby, Dwight, Symington. Chest index — from Dwight and Symington. Natural changes in arch of foot. Hygiene of foot. Ontogenetic development of erect position.
119. ROTH, BERNARD, *The Nomenclature of Spinal Deformities.* Lancet, Lond., 1911, Vol. II, p. 969.
120. ROTH, BERNARD, *Treatment of Lateral Curvature of the Spine.* H. K. Lewis, Lond., 1899. Antero-posterior curves and their relation to lateral curves. Flat foot.
121. ROTH, MATTHIAS, *The Prevention and Cure of Many Chronic Diseases by Movements.* John Churchill, Lond., 1851. Standing, walking, lying.
122. SARGENT, DUDLEY A., *Physical Education.* Ginn & Co., Boston and N. Y., 1906. Need of training correct posture during growing years; relation to school life; proportionate growth of body, etc.
123. SAYRE, LEWIS A., *Orthopedic Surgery and Diseases of the Joints.* Appleton, 1876.
124. SCHNEIDER, F. C. E., *Those Little Postural Defects.* Mind and Body, February, 1912.
125. SCUDDER, CHARLES L., *Seating of Pupils in the Public Schools.* Boston School Document, No. 9, 1892.
126. SHAW, EDWARD, R., *School Hygiene.* Macmillan, N. Y., 1901. Important chapters on school furniture and posture in relation to this and to school life.
127. SHERRINGTON, C. S., Chapter on "The Muscular Sense," in Schäfer's *Text Book on Physiology.* Special application to the erect position. An important study.
128. SMITH, RAE, *Intestinal Indigestion from a Surgical Point of View.* Calif. State Jour. Med., 1911, Vol. IX, pp. 315–320. Considers relation of ptosis to indigestion.
129. STECHER, WILLIAM A., *An Inquiry into the Problem of Desks for School Children.* Mind and Body, April, 1911. Read before the Am. Sch. Hyg. Ass., 1911. An extensive original study for standardizing the heights of unadjustable school furniture in different grades.

130. Stillman, Charles F., *Round Shoulders.* Trans. Am. Orth. Ass., Vol. I, 1889. Discusses in general terms backward yielding of the spine.

131. Symington, Johnson, *Notes on the Effect of Tight Lacing upon the Position of the Abdominal Viscera.* Edin. Med. Jour., 1891, Vol. XXXVI, p. 616.

132. Taylor, Henry Ling, *The Foot in Gymnastics.* Am. Phys. Educ. Rev., December, 1902.

133. Taylor, Henry Ling, *Orthopedic Surgery.* Appleton, 1910. Besides treating of the usual antero-posterior deviations, this book describes and illustrates the various deformities which are likely to be encountered in any physical examination of large numbers of children; of great value to the technical worker.

134. Taylor, John Madison, *Physical Culture in Children. The Objects to be Attained.* Pediatrics, Vol. XII, No. 7, 1901. Discusses erect posture.

135. Taylor, John Madison, *Remarks on the Treatment of the Visceral Ptoses.* Phil. Med. Jour., Jan. 10, 1903.

136. Towne, Lillian M., *A Preliminary Study of Pupils' Attitudes.* Am. Phys. Ed. Rev., March, 1901.

137. Towne, Lillian M., *A Continued Study of Pupils' Attitudes.* Am. Phys. Ed. Rev., March, 1902.

138. Trettien, August W., *Creeping and Walking.* Am. Jour. of Psych., October, 1900. A valuable original study of infant chest development, position of scapulæ, and the physical and psychological elements involved in assuming the erect position and early locomotion. Hygiene of acquiring erect posture. Sleeping positions. Relative proportions of body. Early movements.

139. Turner, Sir William, *Some Distinctive Characters of Human Structure.* Report of Brit. Ass. for Adv. of Sci., 1897. With special relation to the erect attitude.

140. Tyler, John Mason, *Growth and Education.* Houghton, Mifflin & Co., 1907. A very important work for both popular and technical use. Significance of bodily growth and proportions and their relation to education.

141. Uffelmann, Julius, *Manual of the Domestic Hygiene of the Child.* G. P. Putnam's Sons, N. Y. and Lond., 1891. Relation of chest circumference to body length at different ages. Development of physiological curves of spine. Sleeping positions.

142. Warner, Francis, *Physical Expression.* Appleton, 1893. A study of the element of expression in various postures.

143. Whitman, Royal, *A Treatise on Orthopedic Surgery.* Lea & Febiger,

N. Y. and Phil., 1910. Antero-posterior curves and their exaggerations. The foot, its structure, action, and hygiene. Proper chest proportions.

144. WILLIAMS, WILLIAM, *Some Remarks on Chlorosis.* Med. Press and Circ., Vol. 75, June 24, 1903. Relation of tight dressing to anæmia in early adolescence.

II

WORKS CONSULTED ON ANATOMY, PURE AND APPLIED, AND ON PHYSIOLOGY

145. BOWEN, WILBUR P., *The Mechanics of Bodily Exercise.* Published by author, State Normal College, Ypsilanti, Mich., 1909. Anatomy and action of joints and muscles. Chapter on posture.

146. BRAUNE and BELLAMY, *Topographical Anatomy.*

147. CUNNINGHAM, D. J., *Lumbar Curve in Man and the Apes.* Cunningham Memoirs, No. II; Proc. Royal Irish Acad., Dublin. Also in Nature, Vol. XXXIII, p. 378, 1886.

148. CUNNINGHAM, D. J., *Text Book of Anatomy.* Wm. Wood & Sons, N. Y.

149. DWIGHT, THOMAS, *Frozen Sections of a Child.* Wm. Wood & Co., N. Y., 1881.

150. FOSTER, M., *A Text-Book of Physiology.* Macmillan, 1904.

151. GERRISH, F. H., *Textbook of Anatomy.* By American authors; Lea Bros., Phil. and N. Y., 1902.

152. GRAY, HENRY, *Anatomy, Descriptive and Surgical.* Lea & Febiger, Phil., 1908.

153. HUXLEY, THOMAS H., *Lessons in Elementary Physiology.* Macmillan, 1912. The erect position and how maintained.

154. LUCIANI, LUIGI, *Human Physiology.* Macmillan, 1911.

155. MARTIN, H. NEWELL, *The Human Body.* Henry Holt & Co., N. Y.

156. MORRIS, HENRY, *A Treatise on Human Anatomy.* J. and A. Churchill, Lond., 1902.

157. PIERSOL, GEORGE A., *Human Anatomy.* Lippincott, Phil., 1907.

158. QUAIN'S *Anatomy.* Edited by Schäfer and Thane. Longmans, Green, & Co., Lond. and N. Y., 1894. Vol. II, Pt. II, pp. 161–162. Effect of antero-posterior curve of spine on ribs. Effect of obliquity of ribs in respiratory movements.

159. SCHÄFER, E. A., *Text Book of Physiology.* Pentland, Edinborough, and Lond., 1900. Center of gravity in human body. Review of investi-

gations to 1900. Mechanics of different positions and activities, including erect posture and walking. The effect of posture on the circulation.

160. SEAVER, JAY W., *Anthropometry and Physical Examination.* Published by the author, New Haven, Conn.

161. SKARSTROM, WILLIAM, *Gymnastic Kinesiology; a Manual of the Mechanism of Gymnastic Movements.* F. A. Bassett and Co., Springfield, Mass., 1909. A very helpful work in applied anatomy. Discusses the muscular action in various types of poor posture and their correction.

162. VIERORDT, H., *Daten und Tabullen.* Jena, 1906.

III

BIBLIOGRAPHY ON EFFICIENCY METHODS AND SCIENTIFIC MANAGEMENT

163. CARPENTER, CHARLES W., *Profit-making Management.* Published by Engineering Magazine, N. Y.

164. EMERSON, HARRINGTON, *Efficiency as a Basis for Operation and Wages.* The Engineering Magazine, Pub., N. Y., 3d ed., revised and enlarged, 1912. One of the classics on the subject.

165. EMERSON, HARRINGTON, *The Twelve Principles of Efficiency.* The Engineering Magazine, Pub., 1912. A book of fundamental importance.

166. GILBRETH, FRANK B., *Motion Study: a Method for Increasing the Efficiency of Workmen.* D. van Nostrand Co., N. Y., 1911.

167. GILLETTE and DANA, *Cost Keeping.* Published by Engineering Magazine., N. Y.

168. GRANT, *Work, Wages, and Profit.* Published by Engineering Magazine, N. Y.

169. TAYLOR, FREDERICK WINSLOW, *The Principles of Scientific Management.* Harper & Bros., Pub., N. Y. and Lond., 1911. One of the very important books on the subject.

170. TAYLOR, FREDERICK WINSLOW, *Shop Management.* Harper & Bros., 1912.

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